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THE TELEPHONE IN COURT.

We propose to give in this article an abstract of Mr. Morgan Brown's specification of Bell's telephonic apparatus, pointing out what parts have been disclaimed by the disclaimer of Feb. 13th last. The specification is a long one, but as much of it is very material, we shall give the more important parts in the words of the original.

The patent is dated December 9th, 1877, and the invention is entitled, "Improvements in electric telephony (transmitting or causing sounds for telegraphing messages) and telephonic apparatus." The first idea one has on reading the preamble is that the invention is one relating to multiplex telegraphy, but the part which gives this idea has been struck out by the disclaimer, as will be seen from the extract given below, in which those parts struck out by the disclaimer are printed in italics and enclosed in brackets; those added are merely enclosed in brackets and not italicised.

"The present invention relates to the reproduction by the necessary receiving instruments of any particular sounds or combinations of sounds through the agency of an electric current, [*whereby a multiplicity of telegraphic messages may be sent simultaneously over a single circuit in the same or in opposite directions, and received without confusion, and*] whereby articulate speech may be electrically transmitted."

[*"The invention relates to the production or transmission of musical notes by means of undulatory currents of electricity, one battery being used for the whole circuit, whereby two or more telegraphic signals or messages can be transmitted simultaneously over a single circuit or in opposite directions."*] "The invention also relates to the electrical production or transmission [in the manner hereinafter described and claimed] of sounds of every kind by means of undulatory currents of electricity, whereby not only musical sounds but articulate speech can be transmitted over a telegraph line, [*and two or more messages be simultaneously sent over a single circuit in the same or in opposite directions*].

"The invention also relates to the electrical production or transmission [in the manner hereinafter described and claimed] of sounds of every kind without a battery [being used in the main circuit, or used otherwise than in the manner hereinafter described and claimed], by means of undulatory currents of electricity, whereby, not only musical notes but articulate speech can be transmitted over a telegraph line [*and two or more messages be sent simultaneously over a single circuit, in the same or in opposite directions*].

[*"The invention also relates to the automatic reception of signals or messages, by introducing at the receiving end of the line a local circuit, containing a vibratory circuit breaker, whereby telephonic signals or messages may be automatically recorded.*

"The invention also relates to the application of electric telephony to autographic telegraphy, whereby characters or marks of any description may be copied in facsimile at the receiving end of the line]."

The preamble is followed by a description of six plans; the first three of these relate to multiplex telegraphy by intermittent pulsatory and undulatory currents. Only the latter method is claimed in the original specification, and this is disclaimed by the disclaimer. As, however, it bears on the fourth and fifth plans, we give a short résumé of it.

Plan III.

Each transmitting instrument generates by one of the methods hereafter described undulatory currents, and the receiving instrument consists of a spring armature vibrating so as to sound a definite note, there being a different note for each receiving instrument, the instrument at any one place only sounding when the current corresponding in its undulations to the particular tone of vibration of the armature is passing. The method by which the undulatory currents are produced was itself also claimed, but now is disclaimed. The method is to cause a continuous current from a voltaic battery to be gradually increased and diminished in intensity, by the vibration or motion of bodies capable of inductive action, or by the vibration of the conducting wire in the neighbourhood of such bodies; or to increase and diminish the resistance of the circuit by making the current pass through a wire which dips to a varying extent into water, which forms a part of the circuit; or to increase or diminish the resistance of the battery by raising and lowering the plates in the liquid or making the plates approach to or recede from each other.

We now come to

Plan IV.

"In the plans so far described a separate instrument is employed for every pitch, and the electric vibration for different pitches are combined upon the wire, each armature being capable of transmitting or receiving but a single note, and thus as many separate instruments are required as there are messages or musical notes to transmit. In this part of the invention a single instrument is employed, the armature of which can be set in vibration by a musical instrument, or by the tones of the human voice, or by any sound whatever."

One of the ways in which the armature mentioned * may be set in vibration, was stated to be wind. Another mode is the human voice, or musical instrument, or any other sound. The way in which either is done is the following:—Instead of the armature in * being fixed to

* The method which is more particularly described consists in using an electric magnet with a coil round one leg only. A spring

the leg of the electro-magnet, it is hinged, or loosely fixed there. The free end is fixed to the centre of a stretched membrane, which is fixed across the smaller end of a conical tube. The receiver is exactly the same as the sender. It is stated that the receiver imparts to the air (where it is) a *fac-simile* copy of the motion of the air at the transmitter, "hence two or more musical notes, or telegraphic messages, can be sent simultaneously along a single circuit from one station to another by means of one instrument at each station."

It should be noticed by our readers that this apparatus is used with a battery. In the disclaimer it is stated :

"That no claim is made to the use of telephonic apparatus, wherein a membrane like goldbeaters' skin is used in combination with an electro-magnet, excited by a battery which is arranged in the main circuit or line wire, inasmuch as such a membrane was mentioned in descriptions published in England prior to December 9th, 1876, and as such a membrane is of small utility owing to its uncertainty of action caused by changes due to wear or moisture, or atmospheric influences."

The specification proceeds :

"Instead of the cone membrane and armature described above, a plate of thin steel may be used,"

The disclaimer adds :

"with greatly increased advantage as an armature."

The specification proceeds :

"The vibrations of the plate in front of the magnet, occasioned by the motion of the air during the production of sound changes the intensity of the current as hereinbefore described, and occasions a similar motion in a similar steel plate in front of another electro-magnet at another station in the circuit. . . . . This invention is not limited, however, to the use of a steel plate, but includes within its scope any equivalent plate capable of inductive action upon a current of electricity.

"On this plan, an operator at one station may send a telegraphic message on a certain pitch, while another operator at another station is transmitting another message on a different pitch, and both sounds will be audible at all the stations in the circuit. The receiving operators will pay attention to signals of only one pitch, hence by this plan the simultaneous transmission of a number of telegraphic messages over a single circuit, in the same or both directions, with a single wire battery for the whole circuit, and a single telephonic instrument at each station is rendered possible. Whatever sound is made in the neighbourhood of any telephone is echoed in *fac-simile* by the telephones of all the other stations; hence this plan is also adapted for the entirely new use of transmitting intelligibly the exact sounds of articulate speech. All the methods of producing undulatory currents of electricity hereinbefore described, may be employed in producing the undulations by which to transmit articulate messages."

We now come to that part of the specification which deals with the telephone without a battery; hitherto, the specification has merely shown that the plan we marked*, in which a vibrating armature increases or diminishes a battery current, can be extended by using a vibrating steel plate in lieu of the armature. The modern telephone is described as

PLAN V.

"In the fifth plan of the invention the battery is omitted, and a permanent magnet is substituted for the soft iron core of the electro-magnets used in the other telephones," or induction coils may be used, local batteries being placed in circuit with the primary wires, so as to magnetise the soft iron cores of the coils. The undulations induced in the secondary wires by the vibrations of the plates being directed upon the line wire. An illustration is given of the box telephone, and it is stated that the magnet employed may be of a horse-shoe form, the wire being wound round both legs [hitherto it has been described as round one only], and soft iron ends may be fixed on to the magnet, and the wire wound round those ends. "The coils will preferably be very thin, and placed at the extremity or extremities of the magnet. One, two, or more magnetic poles, with coils, may be used to intensify the effect. The soft iron core and coil may be attached to the plate instead of the magnet, or the core may be placed upon the plate, and the coil on the magnet, or *vice versa*. The magnet may be made to vibrate instead of the plate."

No illustration or particular description is given of the trumpet-shaped telephone, the one in general use.

The VI. Plan which relates to the transmission of writing is wholly disclaimed.

We now come to what is perhaps the most important part of all—the claims. These we give as they now stand. They were originally eighteen in number, but are now reduced to eight. The claims struck out are those which refer to Plans III. and IV., and three which claim the means of adjusting the plate and magnet in the box telephone, the sounding box, and speaking tube.

The claims which remain are as follows :

"First. The combination, substantially as set forth and described respectively in the fourth and fifth plans above referred to, of a permanent magnet (or other body capable of inductive action) with a closed circuit, so that the vibration of the one shall occasion electrical undulations in the other or in itself; and this I claim whether the permanent magnet be set in vibration in the neighbourhood of the conducting wire forming the circuit, or whether the conducting wire be set in vibration in the neighbourhood of the permanent magnet, or whether the conducting wire and the permanent magnet, both simultaneously, be set in vibration in each other's neighbourhood.

"Second. The method of transmitting vocal or other sounds electrically by causing the intensity of an electrical current generated as described in the fourth and fifth plans, to vary in a manner proportional to the variations of density produced in the air by the said sounds.

"Third. The method of transmitting vocal or other sounds electrically by causing the intensity and polarity of an electrical current generated as described in the fourth and fifth plans, to vary in a manner proportional to the velocity and the direction of motion of the particles of air during the production of the sounds.

"Fourth. The union upon and by means of an electric circuit of two or more telephones when constructed for operation, substantially as described in the fourth and fifth plans, so that if the plate armature of any one of the said instruments be moved in any manner the armatures of all the other telephones upon the same circuit will be moved in like manner; and if the trans-

armature is fixed to the other, and the free end lies over the bobbin leg. A current being sent through the wire, the armature becomes magnetic and of contrary polarity to the bobbin leg of the electro-magnet. As long as the armature remains at rest, no effect is produced on the current which flows steadily; but when it is made to vibrate by any means, "one of which is by wind," a powerful inductive action takes place, and an undulatory current traverses the wire.

mitter armature be moved or vibrated by sound, like sounds will be produced by the motion or vibration of the armature of the other telephones upon the circuit.

"Fifth. In a system of electric telegraph or telephony, consisting of transmitting and receiving instruments, such as are described in the fourth and fifth plans, united upon an electric circuit, I claim the production in the armature of each receiving instrument of any given motion by subjecting said armature to an attraction varying in intensity, however such variation may be produced in the magnet: and hence I claim the production of any given sound or sounds from the armature of the receiving instruments, such as are above mentioned by subjecting said armature to an attraction varying in intensity in such manner as to throw the armature into that form of vibration which characterises the given sound or sounds.

"Sixth. The combination in the manner described in the fourth and fifth plans, of an electro-magnet with a plate of iron or steel or other material capable of inductive action, which can be thrown into vibration by the movement of surrounding air, or by the attraction of a magnet.

"Seventh. In an electric telephone the combination with the plate of a magnet having coils upon the end or ends of the magnet nearest the plate, substantially as described in the fourth and fifth plans.

"Eighth. In an electric telephone the combination with a permanent magnet and plate armature of a soft iron pole piece forming the core for the coil, substantially as described" in the fourth and fifth plans.

HIGGINS' IMPROVED PRINTING TELEGRAPH INSTRUMENT.

No class of telegraph instrument is, perhaps, more useful for the distribution of information to a large number of stations simultaneously than the kind which prints in Roman type the message transmitted; and in no class has more ingenuity been displayed in effecting improvements which have for their object the production of a compact and simple instrument which can run at a comparatively high speed, and be free from a liability to skip letters, and which, should such skipping accidentally occur, is self adjusting, so that the error may not repeat itself beyond one revolution of the type wheel. Mr. Higgins' improved instrument seems to possess these particular qualifications in a high degree, and is, therefore, well worthy of notice.

The object aimed at by Mr. Higgins is mainly the construction of a printing telegraph instrument which can be worked on a single wire without the aid of clockwork for driving the type wheel.

The instrument consists of the following parts:—Either one or two type wheels fixed to a common axis and driven by a propelment, which is so constructed as to prevent the momentum of the type wheels carrying them beyond the desired point. For this purpose two pallets, carried by a rocking lever, act alternately on the top and bottom of a ratchet wheel on the axis of the type wheel, with pin stops for the pallets to come against at the end of their forward movement. An arrangement is also provided for bringing the type wheel to the zero point.

The armature which carries the pallets is composed of iron and brass, and is magnetised from a large fixed permanent magnet through the arbor of which it forms a part.

The transmitter sends alternate currents; the currents pass through (or cause other currents to pass through) coils or electro-magnets which are placed on either side of the magnetised armature.

The printing is effected by the current being diverted by a magnetic switch which is made rather sluggish of movement, and only acts when the current is caused to flow for a slightly longer time than when the type wheels are being rotated.

The circuit of the type magnets is closed at such times, and the whole force of the battery passes through the printing magnet, or a separate battery may be used for operating the printing.

The printing from one wheel or the other, when two are used, is controlled by an arrangement which traverses a shield to and fro to cover or uncover the paper below the wheel to be printed from, and at the same time brings a support below the printing pad beneath it, and so locks it and unlocks the printing pad under the one not being printed from.

Where figures are not much required one type wheel and a narrower band of paper and lighter printing mechanism may be employed. The arrangement will continue the same, but a greater number of contacts per revolution of the type wheel will be required.

Sixty or more characters may be used, but for the distribution of general intelligence thirty-six will be sufficient with a corresponding key board. For long distances an escapement and train of clockwork are employed, the other arrangements remaining the same; but the shunting magnet puts in operation a local battery instead of diverting the main current. The type wheel axis is connected to and obtains motion from the train by a light intermediate coiled spring; the pulsations are not therefore sensibly felt by the train.

Any form of transmitter which sends alternate currents and can be stopped on either, and when no current is passing, may be employed, provided the motion be regular.

To detach the armature which controls the type wheel promptly from the electro-magnet to which it was last attracted two springs may be employed, which are of such tension that very little force is needed to repel it. The coils most distant from the armature may also be cut off, so as to concentrate the whole force of the current on the other. The inking roller is made of cloth covered with Utrecht velvet.

Fig. 1 shows a vertical section of the instrument; fig. 2 is a plan of the same; fig. 3 is an under side view; and fig. 4 shows separately some of the parts in immediate connection with the type wheels.

A is the electro-magnet for actuating the propelment; it consists of four coils; they are arranged in pairs and are so wound that when excited by the passage of a current the poles facing each other are of opposite signs. Between each pair of poles there is a soft iron tongue B; the two tongues are both mounted upon an axis C, which is built up of iron and brass, the centre portion between the tongues being of brass to prevent magnetic connection between the two tongues. The outer ends of the axis, which are of iron, pass through the extremities of the permanent horse-shoe

FIG. 1.

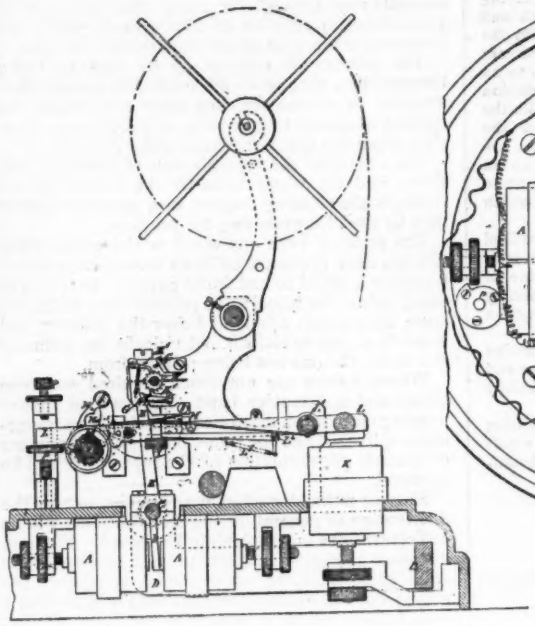

FIG. 2.

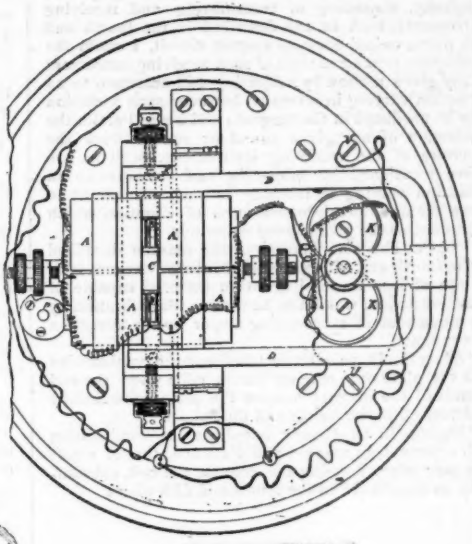

FIG. 3.

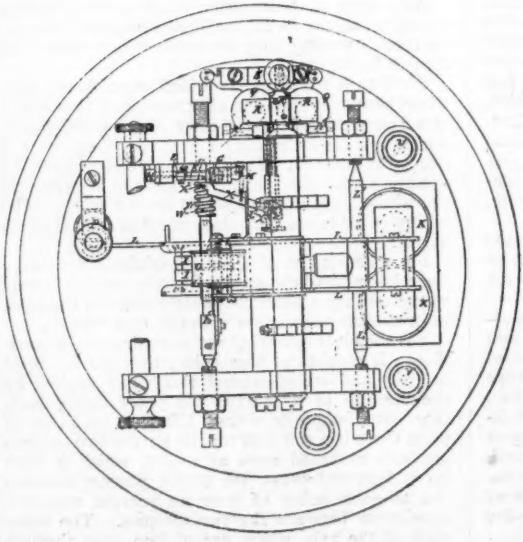

FIG. 4.

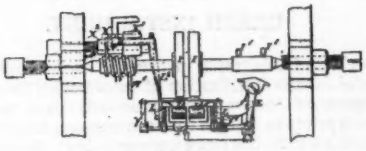

FIG. 5.

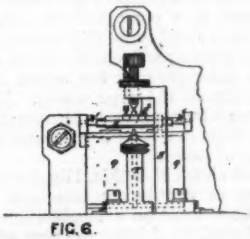

FIG. 6.

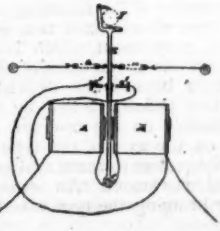

FIG. 7.

magnet D, which thus renders the tongue magnetic by induction. As before mentioned, the sending instrument is arranged to send alternate currents into the line wire, and these passing through the coils A cause each coil alternately to attract and to repel the tongue opposite to it, and so an oscillating movement is maintained for so long as it is desired to keep the type wheels in motion. Upon the axis C is fixed the propelment arm E; it carries two pawls E^1, which act upon the upper and under side of a small ratchet wheel F. These pawls are provided with springs to keep them in contact with the wheel, and screw stops are also provided upon the frame at G, which lock the pawls down at the times when the momentum imparted to the type wheels would otherwise be liable to cause them to over-run; other screw stops H, control the motion of the arm E.

I, I are the type wheels; they are upon the same axis with the ratchetF; K, K arethe electro-magnetic coils, which (when they are called into action, as will be described) operate the printing lever L. This lever turns with an axis L^1, and has the armature of the magnet fixed to it. Where only one type wheel is used the printing lever simply supports at its end a pad over which and below the type wheel the strip of paper to receive the impressions is led, but where two type wheels are employed, as shown in the figure, other arrangements become requisite, which will be presently described. In either case, the strip of paper after leaving the printing lever is passed over the roller M, where a nipping pawl N acts upon it. The pawl N receives its movement from an arm L^2, extending from the printing lever, and it draws the paper forward each time that the lever moves up to print. A second pawl (not shown) acts to prevent the paper moving back with the pawl N.

The types are kept constantly inked by the ink roller O, which rests lightly upon them. Stops P control the motionof the printing lever. Q, Q are the coils of the electro-magnet, which determines the direction which the current takes in its passage through the instrument; it is shown separately in elevation at fig. 5, and its operation is to put the coils K out of circuit so long as it is required that the type wheels should continue in movement; and when the printing is required to take place it places these coils in circuit and puts out the coils A, A. The magnet Q, Q is provided with an armature R pivotted at R^1, and having an arm R^2 carrying a contact spring, which when the armature is held off the magnet by its spring, makes contact with the insulated standard S, but when the armature is drawn down by the magnet through a sufficient distance this contact is broken and another contact is made with a standard T. To follow the effect of this it will be necessary to trace the connections of the instrument, commencing at the coupling screw U; the current passes to the coils Q, Q, but if, as we will suppose, the currents are of the rapidly alternating description employed to rotate the type wheels they will not cause the armature to descend sufficiently to break the upper contact. The currents then pass next through the coils A, A, then by a connection shown in fig. 3 they reach the frame of the instrument, and through this metal they are conducted to the armature R, and thence to the standard S, which is in connection with the other coupling screw V, by which the instrument is connected in circuit. When the right type has been brought round, and it is desired to print, the transmitting instrument maintains a current of one sign for a longer time, and then the armature R leaves its upper contact and completes its lower one.

Tracing as before from the coupling screw U the course of the currents is now as follows:—They first traverse the coils Q, Q, they then pass to the standard T, and so to the armature R, and to the metal of the frame, thence through the coils K, K of the printing magnet to the coupling V.

Where the circuit is long it is sometimes desirable to modify the arrangement by employing a local battery to work the printing lever, in which case the contacts for this local battery are made by means of the armature R.

The arrangement which is employed to enable the operator at the transmitting instrument to ensure that the type wheels of all the receiving instruments in circuit come to the zero point simultaneously and in unison with the transmitter, will now be described. W is a worm fixed upon the axis of the type wheels; and W^1 is a stop pin, which the axis also carries; X is a lever working upon a loose joint at X^1, and carrying a pin X^2, which by the weight of the lever and a light spring is held down so that it enters between the threads of the worm. The worm then causes the lever to move laterally, and if this movement is continued for two or three rotations of the type wheel it brings a shoulder on the end of the lever X into the path of the stop pin W^1, and when the pin comes against the shoulder the rotation of the type wheels is mechanically arrested at the zero point, and no further motion takes place, although the alternating currents may continue to be transmitted through the coils A, A. In the ordinary workingof the instrument, however, before the lever X has been moved far enough to arrest the motion of the type wheel the pause for printing is made, the printing lever rises, and as it does so the projection L^2 upon it strikes up the lever X, lifting the pin X^1 out of the worm, and the spring then draws the lever and pin back to the starting point. Thus it is only when two or three complete rotations of the type wheel is made without any pause for printing that the arrangements described for setting to zero are operative.

The arrangement which determines which of the two type wheels shall print upon the paper is as follows:—The printing lever L carries two pads L^3, one for each of the type wheels; and these pads are not fixed to the lever L but upon arms pivotted to the lever at L^4; L^5 are feeble springs which sustain the pads, but allow them to yield to a light pressure, so that they are inoperative for printing unless otherwise sustained. This additional support is given to the pad which is required to print the paper (by pressing it up to the type wheel) by means of the block Y. This block is carried upon a frame Y^1 capable of sliding transversely upon the lever L, and connected by a link with the T form lever Z, the fulcrum of which is upon a bracket fixed to the printing lever; the transverse sliding of the frame Y^1 to shift the block Y from one printing pad to the other is effected by working the type wheels round until one or other of the two pins I^1 on its axis is brought to such a position beneath the axis that when the printing lever rises the head of

the lever Z is obstructed by the pin 1^1, the lever Z then has to yield, and the lateral movement of the frame Y is effected.

There are blanks on the type wheels, so that no printing takes place at the time when the pins 1^1 operate. One pin 1^1 causes the movement of the frame Y^1 to the right hand and the other to the left. There is an interval of one step of the propelment between the pins. The frame Y^1 also carries a shield of thin and flexible sheet brass, this shield is between the paper and the type wheels. There is a slot in the shield, which permits one type wheel to print, and the other type wheel at the time of printing comes in contact with the surface of the shield, and so cannot mark the paper. The shield yields to the pressure of the type wheel, and so does the free pad 1^3 immediately beneath, so that the full force of the blow is available to bring the paper into contact with the other type wheel. Sometimes for the purpose of aiding the work of the propelment two springs *e*, *e*, are connected with the propelment arm E in the manner represented in fig. 6. The springs are adjusted so that they are nearly but not quite competent to detach the tongues B, B from the magnets when no current is passing in the coils. With the same object the coils A, A on either side of the tongues are caused to be short circuited and automatically thrown out of operation as soon as the tongues recede from them so far that they cease to act with advantage. The coils remain short circuited until the tongues return within their effective range. A simple way of effecting this is shown in fig. 6. The lever E is put into metallic connection with the wire which couples the coils on the right side of the tongues with those on the left; and it also carries two contact-making springs, which, as the lever vibrates alternately, make contact with the two studs E^1, E^1, and so the connections being as the figure indicates, the coils are at the proper times shunted and their resistances eliminated from the circuit. When the circuit is long a clockwork train is employed, and in the place of a propelment an anchor escapement. To give motion to the escapement, a pin fixed in a tongue (similar to B) is caused to engage with horns on the escapement axis in the manner indicated in fig. 7, so that the play of the tongue between the poles is short as compared with that of the escapement pallets. The last wheel of the driving train, which is mounted upon the same axis with the escapement wheel, is not fixed upon the axis, but it is able to turn upon it; and there is a coiled spring connecting the wheel with the axis. This arrangement admits of the driving train running with a regular, or nearly regular, motion, whilst the movement of the escapement wheel and the type wheel in connection therewith is intermittent. In this way a higher speed of working can be attained than would be otherwise possible.

A TRIAL is being made in the central hall of the Houses of Parliament of an electric light. The machine employed to generate the current is one of Gramme's description. The whole of the plant fitted up is supplied by Messrs. Edmunson and Co.

ON THE ALTERATION OF THE THERMAL CONDUCTIVITY OF IRON AND STEEL CAUSED BY MAGNETISM.

By HERBERT TOMLINSON, B.A., Demonstrator of Natura Philosophy, King's College, London.

THE writer has, for several months, been engaged on a set of experiments devised for the determination of the alteration of the electrical and thermal conductivity of iron and steel, with the intention of determining, in absolute measure, such alteration for a given strength of current and imparted magnetism. But as, before the complete determination of the data sufficient for the purpose, a considerable time must elapse, he would venture to offer to the Society, in a preliminary note, some results which have already been obtained by him, as regards the alteration of thermal conductivity produced by magnetism.

In these experiments, the apparatus chiefly employed to impart magnetism consisted of an electro-magnet, with soft iron cores, 1 inch in diameter, and five inches in length, surrounded by cotton-covered copper wire, $\frac{1}{18}$th of an inch in diameter, having a resistance of nearly 1 ohm, and a coil constructed as follows:—a thin tube of polished tin, $1\frac{1}{4}$ inch internal diameter and $4\frac{1}{2}$ inches long, was covered with vulcanised caoutchouc to a thickness of $\frac{1}{16}$th of an inch, and on this was wound 3 lbs. of cotton-covered copper wire, $\frac{1}{30}$th of an inch diameter, followed by 3 lbs. of wire, $\frac{1}{10}$th of an inch in diameter. Inside the first tube was placed a second, 1 inch internal diameter, connected by ebonite with the first at the two ends, the second tube being concentric with the first, and of the same length, so that, between the inner tube and the outer, should be interposed a layer of air nearly $\frac{1}{8}$th of an inch in thickness. This arrangement was employed to prevent the heat from the magnetising coil reaching the bars placed inside; also, to prevent ingress or egress of heat; the bars used with the coil were covered with vulcanised caoutchouc, so that they lay with their axes coinciding with the axis of the coil.

To measure the heat conducted along the bars two sets of thermo-elements were constructed. The first was made up of two small strips of copper, $\frac{1}{2}$ inch long and $\frac{1}{4}$ inch broad, of small thickness. To these was soldered about 1 foot of silk-covered german-silver wire $\frac{1}{30}$th of an inch in diameter, the copper strips being also connected with a galvanometer by copper wires, well covered with caoutchouc, one end of each being soldered to the copper strips, so that either one or both the copper strips with the soldered German-silver wires could be employed as a thermo-element. In case it was found convenient only to employ one of these, the other was kept well covered with sawdust. These elements will be called the G. S. elements. The second set consisted of two small thermo-piles, each of twelve elements, of antimony and bismuth, and were each fitted into india-rubber tubes, so that they could be inserted into small wooden boxes, containing water, so as to fit water-tight. Sometimes these, like the G. S. elements, were used separately; at others, were made to neutralise each other's effect on the galvanometer.

To measure the current produced by these elements, a delicate Thomson's reflecting galvanometer, having a resistance of 2 ohms, was employed, the scale being placed 6 feet from the mirror of the needle.

To measure the strength of the magnetising current, a tangent galvanometer, of Gaugain's construction, was used. The needle was suspended by a very fine platinum wire, attached to a graduated torsion circle. The two thick copper wires which conveyed the current were each 27 centimetres in diameter and 14 inches apart. The needle was also provided with a mirror, so that small deflections could be read off as in a reflecting galvanometer.

A magnetometer was also employed to test the magnetism imparted, but, as the readings will not be given in this paper, no description of the instrument is necessary.

To heat one end of the bars two large Leslie's cubes were employed, having each two apertures projecting about 2 inches into the interior of the cubes. The apertures in one cube were ½ inch square and placed in one side of the cube, about 3 inches apart from each other, and half way up the side. In the other cube the apertures were circular, and ½ inch in diameter, and placed in the centres of opposite sides of the cube. Into these cubes bars of square and circular section were respectively inserted, and water filling the cubes was raised to 100° C.

The first experiment was made on a soft iron bar, ½ inch square, in section. The bar was inserted into the Leslie's cube with square aperture, filled with boiling water, and into the other aperture was inserted a brass bar of the same section. The length of the iron bar was about 10 inches, and of the brass one, 18 inches. One of the G. S. elements was fastened on to the iron bar, and the other to the brass, by caoutchouc bands, the elements being insulated from the bars by thin paper. The G. S. elements were made to very nearly counteract each others effect by sliding one or other of them up and down the bars until the heat conducted by the bars to the elements was in both the same as nearly as possible. Underneath the bar was placed the electro-magnet, with a piece of white cardboard lying on the upper extremities of the soft iron cores, so that the cores were about 3 millimetres from the iron bar; the bar was also propped by a wooden support at the other end. A preliminary experiment had been made for the purpose of ascertaining whether the heat radiated from the electro-magnet would affect the thermo elements to any appreciable extent, and this was not found to be the case.

The water in the cube was now kept boiling for about nine hours, and after that time had elapsed it was ascertained that the flow of heat from one part of the bars to another compensated the loss from radiation and the light on the scale remained stationary. (It should be observed that, as it was impossible to cause one thermo element exactly to neutralise the other, a slight use of the adjusting magnet of the galvanometer was made to bring the light near the zero of the scale.) The current from a single bichromate cell was now sent through the coil of the electro-magnet. In a few moments the spot of light began to move very slowly across the scale in a direction indicating that the flow of heat through the iron bar was being checked, and in about fifteen minutes a deflection of about 25 divisions of the scale was obtained; the current of the cell was then stopped, when the light began slowly to return, and finally settled in apparently the exact position which it held before sending the current through the coil. This experiment was repeated several times on the same day, and on several other days, but always with the same result as regards direction, namely, showing a diminution of the flow of heat from longitudinal magnetisation.

As it was thought, however, that the electro-magnet might when in action perhaps produce an apparent diminution of flow of heat by slightly disturbing the bar in its position in the aperture, though every precaution had been used to prevent the chance of this, the bar in the next set of experiments was securely soldered into the cube, and again tested as before. Here, again, some five or six trials gave the same result, and seemed to show most conclusively that the thermal conductivity of soft iron is diminished by longitudinal magnetisation.

As the method of observation, however, was tedious, and would give no idea of the amount of alteration of conductivity, other expedients were now adopted.

A piece of soft iron, which we will call B C, ½ inch long, ½ inch broad, and 2 millimetres in thickness, was soldered to two pieces of brass, A B, C D of the same breadth and thickness.

A B was 2 inches long and C D, 1 inch. The piece A B was also soldered to another piece of brass A E, having a section ½ inch square, and length about twelve inches.

The whole was placed inside a wooden box, 2 feet long, 1 foot wide, and 2 feet high, lined on the outside with tinfoil.

A E passed through a circular hole, 2 inches in diameter, in the middle of one end of the box, and through two corresponding circular holes in a double screen of sheet tin, and thence into one of the square apertures of one of the Leslie's cubes. The electro-magnet was placed underneath B C, and two pieces of soft iron, about 3½ inches in length, ½ inch in breadth, and about 2 millimetres in thickness, were placed on the ends of the soft iron cores, so as to be on the same level with B C, and distant from B and C about 2 millimetres, the pieces of iron being separated from the cores by a piece of white paper. In some experiments the pieces of iron thus used were carefully secured to the electro-magnet by elastic straps, and, in others, by weights placed on them. A preliminary experiment, made with the strongest current that was ultimately used with the electro-magnet, showed that neither were the iron pieces on the cores appreciably shifted on magnetising the coil, nor was the heat radiated from the coil sufficient to produce any effect on one of the G. S. elements fastened by elastic bands to the back of C D. The other G. S. element was in this case buried in sawdust, with which the box was now filled, so as to cover completely the bars and electro-magnet. The sawdust also filled the space between A B and C D, and the small portion of the brass bar A E, which was between the box and the Leslie cube, was covered with caoutchouc and cotton wool.

The lid of the box was now put on, and some time

allowed to elapse until the light remained steady on the scale.

Boiling water was then put into the cube, and a burner placed underneath. Very shortly the light began to move across the scale, showing that the heat had been conducted along the compound bar to the thermo element, and that the number of divisions on the scale passed over by the light was taken for each minute. The adjusting magnet of the galvanometer had in these and similar experiments to be placed very low down in order that the number of divisions of the scale passed over might not exceed 60 per minute. When the light reached one end of the scale the adjusting magnet was used to bring it back again to the other. In these and similar experiments it was found that, after some time, either the number of divisions passed over per minute increased or diminished very slowly or else remained constant for some minutes. The following observations were made with the specimen in question, the light being near one end of the scale. The number of divisions passed over in consecutive minutes was as follows (the magnetising current will be called M. C.) :—

A	B	C.	D
M.C. not flowing	M.C. flowing.	M.C. not flowing	M.C. flowing.
1st min. 40	1st min. 34	1st min. 31	1st min. 28
2nd min. 39	2nd min. 34	2nd min. 33	2nd min. 29
3rd " 38	3rd " 33	3rd " 31	3rd " 27
4th " 34	4th " 31	4th " 31	4th " 29
5th " 36	5th " 32	5th " 30	5th " 28
No. of divisions in last 4 min. = 147	No. of divisions in last 4 min. = 130.	No. of divisions in last 4 min. = 125.	No. of divisions in last 4 min. = 113.

The light was then near the other end of the scale, so the adjusting magnet was employed to bring the light back again. The set of experiments here given, the first of many, is rather an unfavourable one, most of them giving results much closer together than those here given, and in several instances the flow of heat would seem perfectly steady for upwards of fifteen minutes.

The observations of the first minute in each case were not taken, in order to avoid error from very slight deviations of the galvanometer needles caused by the action of the electro-magnet, which, however, was placed at such a distance from the galvanometer, and in such a position as not, in most cases, to produce any such deflection, and to give time for the magnetism to produce its effect on the bar. It has been determined that in experiments made in this manner, 1 minute seems quite sufficient for the above-mentioned purpose.

Taking A and C together, we obtain as a mean 136 divisions passed over in four minutes with the M. C. flowing, as against 130 from B with the current flowing; again, from B and D, with the current flowing, we obtained 121·5 as against 125, with the current not flowing, so that, in both cases, there is a less mean flow with the M. C. flowing than when it is not flowing. The mean of this particular set of experiments would give a decrease of flow, when the bar is magnetised longitudinally, of about 3·6 per cent of the whole for a magnetising current, causing a deflection of the needle of the galvanometer of 18·6°. The mean of all the observations for the specimen, and for this current, gave a decrease of flow amounting to 3·3 per cent. of the whole.

The electro-magnet was now turned through 90°, so as to magnetise the iron transversely, and a similar set of experiments were made.

Here, again, the result was most conclusive, and the mean of several observations showed an *increase* of flow when the bar was magnetised transversely, amounting to about 3·2 per cent. of the whole for the same current strength.

Thus, the decrease of conductivity in one case seems roughly to be equal to the increase in the other, but it is the intention of the author to make further researches into this part of the inquiry.

The batteries employed in these and subsequent experiments were slight modifications of Daniell's batteries, which, though having a very small resistance, maintained a constant current for some hours. These batteries the writer hopes to have the honour of describing to the Society on a future occasion.

Similar experiments were next made on a piece of hard steel, of similar dimensions to those of the iron, but the length of the brass bar, A E, was considerably shortened.

The result of the experiments proved that there was a decrease of flow, amounting to about four per cent., of the whole, when the bar was magnetised longitudinally with a current producing a deflection of 18° on the tangent galvanometer, and an increase of flow when magnetised by a current of 10° C. transversely, amounting to about three per cent. of the whole (unfortunately, through accident at the time, the same magnetising current as used for longitudinal magnetisation could not be employed).

This last result was rather unexpected, as, though Sir William Thomson has shown (Phil. Trans., Feb. 28, 1856) that the electric conductivity of hard steel is diminished when the steel is magnetised longitudinally, some experiments of the writer in the same direction (Proc. of Royal Society, June 17, 1875) seemed to show that, in the case of hard steel, the contrary effect is produced, while Joule has proved (Phil. Mag., 1847) that, while a bar of iron, or even steel which is so hard that a file will just touch it, is lengthened by longitudinal magnetisation, that iron, under great strain, or steel so hard that a file will not touch it, is shortened.

Of course, the mere act of soldering the steel to the brass would, to a certain extent, soften the steel.

In order, therefore, to avoid soldering, a bar of steel of circular section, ¼ inch in diameter and about 12 inches in length, was made so hard that it could not be touched with a file, and placed, with the usual precautions, on the poles of the electro-magnet, at a height of about 3 millimetres above the cores of the electro-magnet, one of the G. S. elements being secured to one end and the other end inserted in a Leslie's cube. But here, again, there was undoubtedly a decrease of conductivity, when the bar was magnetised longitudinally. Of course, however, the mere fact of heating the bar at one end to the temperature of boiling water would tend to soften the bar, and the writer is not quite satisfied but that it may be ascertained that, for low temperatures, the conductivity of hard steel is increased. It is intended, therefore, to make experiments on iron and steel, at different temperatures,

both high and low, with a view of definitely settling this point.

Some experiments were next made with the magnetising coil described in the beginning of the paper, but the effects produced were found to be so much less for the hard steel than when the electro-magnet was employed that it was found necessary to use the thermo-piles, also mentioned above, and instead of employing the compensating magnet to bring the light on to the scale to cause the two piles, as much as possible, to neutralise each other's effects. Accordingly the following arrangements were made :

Two bars of hard steel, each 3½ inches long and ½ inch in diameter, were soldered at each end to two copper rods, each about 4½ inches in length and ½ inch in diameter. One copper terminal of each rod was inserted into a Leslie's cube, filled with water kept at the boiling point by means of a burner to a distance of 2 inches, and the other terminal into a small wooden box, varnished inside with shell-lac, and capable of containing about 120 cubic centimetres of water. The bars were well covered with caoutchouc ; and double screens and two thermo elements were so arranged as to send their currents through the galvanometer in opposite directions, the wires connecting them with each other and the galvanometer being well covered with gutta-percha, and passing through small holes in the sides of the boxes. The two compound bars were thus made as exactly similar as possible, and also similarly placed, the only difference being that produced by the magnetising coil, whose axis coincided with that of the steel bar placed inside it.

Both the small boxes had originally the same quantity of water placed in them, and a previous experiment had shown that so exactly similar was the heat conducted along the bars to the water in the boxes, that when some two hours or so had elapsed, the rise of temperature of the water in each box seemed as measured by an ordinary thermometer, marked off in degrees centrigade, to be exactly the same, namely, 10° C.

But as the same experiment had shown that the pile in one of the boxes was very slightly more powerful than the other, the water in the other box was diminished very carefully by means of a small siphon, formed of india-rubber tubing, of very small bore, which was kept closed by a pinch-cock at one end, the tube passing through holes cut in the large box, through the sawdust, and through a small hole cut in the lid of the small box, so as to dip into the water. The little siphon was always kept charged, and, by means of the pinch-cock, any desired small quantity of water could be extracted from the box.

By this means it was found easy to make one pile so neutralise the other that a very slight use (if any is necessary) of the adjusting magnet was required, even when the magnet was near its most sensitive position with respect to the galvanometer needle.

On sending a current through a coil around the steel bar, it was in a minute or so seen that the conductivity of the hard steel was diminished by the longitudinal magnetisation, and the amount of diminution was roughly determined by finding the amount of water necessary to be extracted from the box to again bring the light to the same slow rate of motion (about two divisions per minute) which it had before passing the magnetising current, and comparing this with the original amount of water in the box. The decrease of flow did not amount to 1 per cent. of the whole, even with the strongest battery used (current shown by the tangent galvanometer, 26°).

This plan was found to be highly successful for determining whether there was a diminution or not, but not equally so for determining the amount of decrease, owing to the great difficulty in this method of quickly making the light move at the same rate after magnetisation as before. Another method was therefore tried, which promises to give better results.

The two piles, P_1 and P_2 were joined up with the galvanometer and a shunt S, so as to obtain equilibrium, according to Poggendorff's method of comparing the electro-motive forces of batteries.

The same quantity of water was now put into each box, and the pile P_1 being slightly more powerful than P_2, the shunt S was adjusted until there was little or no motion of the light on the scale.

The magnetising current was then passed through the coil, and the shunt again adjusted, until the piles neutralised each other.

It can be shown that if x_1, x_2 be the units of heat imparted to the water in the two boxes in the same time, $\frac{x_2}{x_1} = \frac{S}{R + S}$ when the piles neutralise each other, where R is the resistance of the portion of the circuit in which P_1 is placed.

If, then, dx_2 be the diminution of flow caused by magnetisation, and dS the diminution of shunt resistance necessary to again make one pile neutralise the other,

$$\frac{x_2 - dx_2}{x_1} = \frac{S - dS}{R + S - dS}$$

$$\therefore \frac{dx_2}{x_2} = \frac{R \times dS}{S\,(R + S - dS)}$$

and thus the per centage of diminution of flow may be determined.

A few resistance coils were very roughly constructed for use in the shunt S, and an attempt made to ascertain the actual amount of diminution of conductivity of the hard steel. This, again, appeared to be comparatively small, but as the coils used were not suitable for the purpose, the result is not given. But the writer has little reason to doubt but that, with resistance coils suitable for such thermo-electric experiments, he will be able to measure, with fair accuracy, small variations of thermal conductivity in this way.

It should be added that similar experiments to these were made with soft iron bars, both with and without copper terminals, but the results of the experiments, of which altogether upwards of a hundred have now been made, show that in every case the thermal conductivity of soft iron is diminished by temporary longitudinal magnetisation, and increased by transverse magnetisation, whilst in the case of steel, of different degrees of hardness, at any rate, for the temperatures employed, magnetisation evidently produces the same kind of effect as with the soft iron. The amount of the alteration in the case of soft iron must have reached

at least as high as 10 per cent., and may be greater. The experiments which the writer has made on electrical conductivity have shown that this is also very appreciably altered by magnetism, at least 6 per cent., even when the magnetisation was evidently not complete (Proc. of R. S., June 17, 1875), and has some reasons for believing that the amount of alteration for thermal and electrical conductivity will be found to be not very different. He hopes, however, to thoroughly investigate the whole subject.

It should be mentioned here that Sir William Thomson (Phil. Trans., Feb. 28, 1856) expresses a strong opinion that the experiments of Dr. Maggi on this subject, on which he says doubts have been thrown by others, would be found correct, basing his opinion on the results of his own experiments on the alteration of electrical conductivity by magnetism. And, though the writer had some years ago made some attempts in the present direction (unfortunately before perusing Sir William Thomson's exceedingly valuable paper), he cannot conclude without expressing how greatly the suggestions there thrown out have assisted him in these and other experiments.—*Proceedings of the Royal Society.*

TELEGRAPH POSTS IN JAVA.

THE supports used for carrying the system of telegraph wires through the Island of Java merit a short description.

These are formed of the trunk of a tree known as the "Kapas" tree, which derives its name from a species of short fibred cotton which it produces. This tree possesses the two following advantages, which fit it admirably for the purpose. In the first place, when a tree is cut down, and the upper or branched part cut away, it possesses such an amount of vitality, that when placed in the ground it will at once form new roots and branches, thus effectually protecting it from the ravages of the white ants who would soon make very short work of an ordinary telegraph post. Secondly, the branches always spreading out horizontally never come in contact with the wires or insulators.

Another advantage lies in their elegant appearance as contrasted with a similar number of bare poles.

When once planted, probably no further attention would be necessary, and unless blown down by a gale (which their form would render unlikely) or damaged by lightning, they would last for very many years.

PHOTOGRAPHING FROM BALLOONS.

MR. W. B. WOODBURY has conceived the ingenious idea of elevating a photographic apparatus in a balloon, and manipulating it there, from *terra firma*, by means of electricity, so that a picture of the country underneath may be obtained without any of those personal risks which still attend the ascent of the aeronaut. It will be at once obvious that Mr. Woodbury's plan might prove useful in military operations. In times of war it would be possible in this way for a besieging army to obtain a photograph of the fortifications it was bent upon attacking, or for a beleaguered city to get a bird's eye-view of the surrounding country, comprising the camps and entrenchments of the enemy. The balloon is, of course, held captive by a rope or cable, along which the electrical wires are laid. In the position ordinarily occupied by the car, a box, open at the bottom, is attached. To one side of this box the cable is connected, and to the other is fixed a species of sail or rudder designed to keep the balloon from turning round. Inside this box-car a second box is swung on a pivot, so that it may keep horizontal. This inner box contains the necessary photographic apparatus, consisting of the lens which is placed in the bottom, a dark slide having two rollers carrying the sensitive tissue, moved by clockwork, and an electro-magnetic arrangement for guiding its movements and likewise working an instantaneous shutter placed immediately over the lens. The clockwork is set in motion and also arrested at will by electric communication with the earth, thus exposing a fresh length of the sensitive paper as required. The shutter is a dish of ebonite or metal having an aperture at one side, and is made to revolve rapidly in front of the lens every time it is released by a catch acted on by an electro-magnet excited from the earth. The circuit for controlling the clockwork, and that for working the shutter, involve three wires of communication. When the balloon is elevated to the required height, the lens properly focussed, and the tissue in position, the shutter is set in motion by the current giving instantaneous exposure. A photograph is thus obtained; and by further controlling the clockwork, fresh sensitised surface may be exposed, and additional images taken. This arrangement has been patented by Mr. Woodbury.—Patent No. 1647, year, 1877.

EARTH CURRENTS.

By CHR. DRESING, of the Great Northern Telegraph Company.

HOPING to obtain some few additional facts to our present unsatisfactory knowledge of earth currents, I and Mr. Terp, the company's superintendent, a couple of years ago commenced a series of observations of earth currents on the Scotch-Norwegian Cable. The line being a busy one, was only occasionally (and especially on account of an interruption of the Norwegian and Scottish lines) at our disposal, and though the observations in consequence could not be carried out as frequently as could be desired, the following table, *which is a fair specimen of all the observations*, will be sufficient to demonstrate a certain regularity in the *diurnal variations* of the *strength* and *direction* of the natural current.

I may remark, that the deflections noted are readings from the scale of an *ordinary*, but sensitive *detector* of a resistance of about 1,200 ohms, and the

strengths of the current and the deflections are not directly proportional to one another.

Date.	Time.	Deflection. +	Deflection. −	Remarks.	Weather.
Jan. 1	8 0 a.m	..	38	Steady deflection	N.E. breeze
—	9 40	0	0	Changing direction	[fine.
—	10 40	65	..	Steady	
—	12 40 p.m	63	..	*i.e.*, equal to 4 Leclanche's cells	
—	2 0	60	..	Steady	
—	3 10	54	..	"	
—	3 40	47	..	"	
—	4 30	15	..	"	
—	4 50	0	0	Changing direction	
—	5 0	..	10	Steady	
—	5 30	..	30	"	
—	6 0	..	45	....	
—	6 30	..	50	Steady; increasing	
—	6 45	..	53	....	
—	7 30	..	55	....	
—	8 35	..	50	Steady; decreasing	
—	9 46	..	10 to 35	Swinging	
—	10 15	..	..	Changing direction	
—	10 50	40	..	Steady; slowly increasing	
Jan. 2	12 0 a.m	48	..	....	
—	1 15	50	..	....	
—	7 50	..	86(?)	Steady	Fine; frosty.
—	8 25	..	55	....	
—	8 50	..	52	Unsteady	
—	9 45	..	42	Steady; decreasing	
—	10 0	..	..	Unsteady; swinging across zero	
—	12 0 noon	45	..	Unsteady	
—	1 0 p.m	59	..	Steady	
—	1 46	58	..	"	
—	2 25	59	..	"	
—	3 38	48	..	"	
—	4 0	12	..	"	
—	5 0	..	..	Changing direction	
—	5 35	..	25	Constantly increasing	
—	6 57	..	55	" "	
—	8 57	..	58	Steady	
Jan. 3	8 40 a.m	..	55	....	Fine weather;
—	10 0	..	45	Steady; decreasing	[frosty.
—	11 15	..	..	Changing direction	
—	11 30	25	..	....	
—	1 15 p.m	53	..	....	
—	2 47	58	..	....	
—	3 45	56	..	....	
—	5 50	30	..	Rapidly increasing	
—	6 0	..	..	Changing direction	
—	6 30	..	8	Steady; increasing	
—	8 30	..	60	Steady	
—	10 5	..	59	Decreasing	
Jan. 4	12 32 a.m	..	..	Swinging across zero	N.E. gale.
—	8 15	..	45	Steady	
—	11 20	..	13	Rapidly falling	
—	11 57	..	..	Changing direction, gradually assuming positive tendency	
—	12 52	30	..	....	
—	1 50	45	..	Variable	
—	2 38	45	..	"	
—	4 2 p m	50	..	"	
—	6 20	39	..	Steady	
—	7 7	27	..	"	
—	7 15	16	..	"	
—	7 36	..	..	Changing direction	
—	7 45	..	15	....	
—	8 45	..	34	Steady	
—	10 55	..	43	"	
—	11 40	..	42	"	
Jan. 5	7 30 a.m	15	..	....	N.E. gale.
—	8 0	..	..	Changing direction	
—	9 40	..	30	Variable	
—	10 20	+20 to	−40	Very variable	
—	11 30	..	30	Steady	
—	12 45 p.m	+30 to	−30	Very variable	
—	12 58	..	5	....	
—	1 30	..	..	Changing	
—	1 50	15	..	....	
—	3 0	34	..	....	
—	3 40	40	..	Variable	
—	4 10	43	..	Steady	
—	4 45	45	..	....	
—	6 13	38	..	Decreasing	
—	8 0	..	..	Changing direction	
—	8 15	..	9	....	
—	10 17	..	48	....	
—	11 15	..	55	....	
Jan. 6	1 0 a.m	..	50	Decreasing again	

From this table and from all my numerous observations, which have tended to confirm the above results, without however, throwing any new light on the subject, the following conclusions may be derived :—

1st.—That there is always a natural current flowing through the cable.

2nd.—That this current is sometimes flowing from Scotland to Norway, sometimes in the opposite direction.

3rd.—That the current after each change of direction increases gradually, from a minimum to a certain maximum strength, and then again decreases until, after passing the zero-point, which only occupies about a minute, it assumes an opposite direction.

4th.—That the change of direction takes place about every six hours, *i.e.*, 4 times in the 24 hours.

5th.—That the *normal maximum strength* of the *natural current*—as proved by proper measurement—scarcely ever exceeds 3 to 4 Léclanché's cells.

6th.—That great *meteorological* disturbances *usually* are preceded, accompanied, or followed, by similar *electric* disturbances in the cable.

EFFECTS OF ELECTRIC CURRENTS OF HIGH TENSION.

FOLLOWING up a series of former notices, M. Tissandier, in *La Nature*, gives an account of some of the recent experiments of the eminent French physicist, M. Gaston Planté, with his large battery of secondary elements. This battery consists of 800 pairs, and is arranged in sets of 40 pairs each.

Before commencing work, the pairs are joined up for "quantity" by means of commutators, and are then charged or polarised from a few Bunsen cells. When the battery has not been long unused, a few hours suffice for the charging. By turning the commutators, the battery can then be arranged for "tension" and discharged at pleasure, either immediately, or after some time.

The experiments are usually conducted in a darkened room, in order to study the luminous phenomena produced.

Electro-silicic light.—If a platinum wire, passed through a small glass tube, be immersed in a solution of potassium nitrate, and connected with one of the poles of a secondary battery of 60 couples, an electrode from the other pole being previously immersed, the lower end of the tube is fused within the liquid and gives out a dazzling light (fig. 1). The end of the platinum wire is found to be sealed into a small globular mass of fused glass, and the light is vividly maintained until the cooling of the glass insulates the wire from the liquid. When a solution of sea-salt is used, from 250 to 300 couples are required to produce a similar effect. The manner in which saline solutions behave, in presence of the silica in the glass raised to high temperature by the passage of the current, is, in fact, very varied, in consequence of the greater or lesser fusibility of the silicates formed, a fact already recognised by M. Carré in combining various salts with the carbons employed to produce the ordinary electric light.

This vitreous light may also be caused by bringing either of the electrodes near a plate of glass at a little distance below the surface of a saline solution

fig. 2). In this case the light is accompanied by the giving off of white vapours, the glass being at the same time strongly attacked. The light may also be produced at the edge of a porcelain dish, and is then comparable with that of the voltaic arc in M. Jablochkoff's electric candles.

The luminous phenomena observed with glass, by means of induction currents, by MM. du Moncel, Gassiot, Grove, &c., may likewise be compared with that treated of here.

One might be led to attribute the brilliancy of this light to the lime combined with the silica in glass, but an examination of the spectrum it gives shows no appreciable lines, whilst a fragment of

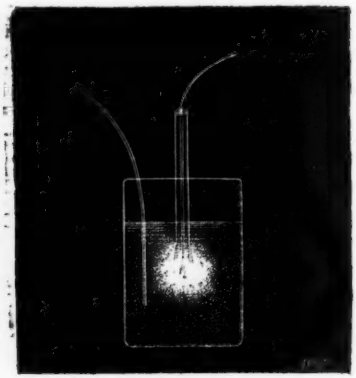

FIG. 1.

calcareous spa, subjected to the same conditions, not only gives a vivid light, but also shows the characteristic lines of calcium.

The lines of silicon being feeble, according to M. Kirchoff's analysis, it is conceivable that they should not be detected, by reason of the intensity of the spectrum formed; but the *silicic* origin of this light

FIG. 2.

is proved by the important fact that it is reproduced with pure silica in the form of transparent quartz crystals (fig. 3). It is only necessary, in this case, to employ, with the same saline solution, a somewhat greater force, say 100 secondary couples. The silica itself being decomposed by these currents of high tension, the luminous effect results, according to all appearance, from the incandescent silicon, analagous effects to which have been shown by MM. Sainte-Claire Deville and Wöhler with diamond and graphite. To distinguish the light observed by him from that obtained with carbon points, M. Planté has given to it the name of *electro-silicic* light.

Etching on Glass.—In a series of analogous experiments, M. Planté noticed that the luminous veins or rings formed round the positive electrode of a powerful battery remained sometimes graven on the surface of the glass voltameter containing a saline solution, and this observation led him to apply the electric current to etching on glass or crystal. The surface of the plate of glass or crystal is covered with a concentrated solution of potassium nitrate by simply pouring the liquid over it in a shallow vessel. A platinum wire is laid round the object, within the liquid, and is connected with one pole of secondary battery of 50 or 60

FIG. 3.

pairs; another platinum wire insulated, except at its extremity, is taken in the hand and the required design traced out on the surface of the glass or crystal. A luminous furrow is produced wherever the wire touches, and whatever the speed with which the writing or design is traced out, the track is left neatly engraved upon the surface. If the speed is slow, the track is deep; its width is dependent upon the diameter of the platinum electrode; if this be drawn to a point, the writing may be made very delicate. The wire conveying the current becomes thus a specially adapted graver for glass, and, in spite of the hardness of the surface to be cut into, requires no special effort on the part of the operator, for it is only necessary to pass the wire lightly over the surface to obtain an ineffaceable engraving. The corroding force is furnished by the action, at once thermic and chemical, of the electric current in presence of a saline solution.*

* The figures produced on glass by static electricity and the impressions obtained by Mr. Grove with induced currents, are comparable with these effects produced on glass by dynamic electricity. But as the quantity of electricity

Although these results have been obtained with the aid of a "secondary" battery, M. Planté states that for continuous work any other source of electricity of sufficient quantity and tension may be employed, whether a Bunsen battery or a Gramme machine, or even a magneto-electric machine giving alternate currents.

This novel application of electricity appears fitted to be of service in the glass industry, and to offer some advantages over the unhealthy methods at present in use.

BECQUEREL.

WE are now able to give a likeness of Antoine Cesar Becquerel, the illustrious French physicist and electrician, lately deceased. Becquerel died on January 18th, at the advanced age of ninety years. A full account of his life and works is to be found

in the TELEGRAPHIC JOURNAL for Feb. 15th. His scientific labours extended over a wide field, but his fame chiefly rests on his electro-chemical discoveries. His son, Edmond Becquerel, is worthily pursuing his father's favourite lines of research. We are indebted for the portrait to *La Nature*.

THE POSTAL TELEGRAPH DEPARTMENT.

THE estimates for the financial year commencing April 1st, 1878, which have lately been published, show that the Engineering Department of the Postal Telegraph Service, has undergone a reorganisation. Under the new constitution the following will be the principal strength of the force :—

Engineer-in-Chief's Office.

1 Engineer-in-Chief.
1 Assistant Engineer and Electrician.
1 Submarine Superintendent.
1 Assistant do.
4 Superintending Clerks.

Controller of Stores Office.

1 Controller of Stores.
2 Superintending Clerks.

Metropolitan and Provincial Force.

1 Divisional Engineer (Ireland).
1 Superintending Engineer (London).
4 Superintending Engineers, 1st Class.
10 „ „ 2nd „
2 Inspectors, Senior (London).
20 „ 1st Class.
41 „ 2nd „

Royal Engineers.

2 Superintending Engineers, 2nd Class.
3 „ „ „
4 Inspectors, 1st Class.
5 „ 2nd „

Factories.

1 Superintendent.
1 Assistant do.
1 Inspector.
1 Foreman of Mechanics.

Telegraph Instruction.

1 Superintendent.
1 Assistant.

THE PHONOGRAPH AND VOWEL SOUNDS.

IT has been pointed out by Professor Fleeming Jenkin, and Mr. J. A. Ewing, in a letter to *Nature*, that whereas rotating the barrel of the talking phonograph at different speeds gives corresponding differences of pitch in the sounds, it does not alter their quality. This result appears to disagree with Helmholtz's theory that the characteristic quality of each vowel is given by the predominance of a constituent note of definite pitch in the sounds uttered. For the absolute pitches of the constituents of the vowel sounds in the experiments in question were all altered in the same proportion, so that the absolute pitches of the predominant notes varied greatly; yet the vowel quality was unchanged. Another fact has been elicited in these experiments, namely, that if a scale be sung into the phonograph with one vowel sound, such as O, the wave-form of the marks on the tinfoil does not remain unchanged at all pitches.

THE late severe snowstorms and gale have caused serious interruptions to the telegraphic communication in various parts of the country, and especially in the West of England and South Wales.

furnished by electrical machines or induction coils is, relatively, very small, and as there is also no electro-chemical effect such as is here produced in presence of a saline solution, these figures and impressions are very indistinct. To be seen they require a deposit of dew or the moisture produced by breathing, for which reason they have been named "figures roriques" (*ros, roris, dew*) by MM. Reiss, Peyré, Wartmann, &c.

Notes.

TELEPHONIANA.—In a paper recently read before the King's College Engineering Society, Mr. C. W. Cunningham compared the vibrating plate with the tympanic membrane of the ear, and pointed out that the predominance of the fundamental note of a flat plate will drown a large number of the overtones of the voice, and thus cause the observed peculiarity of the telephonic voice. The tympanic membrane, on the contrary, being of a funnel shape, is peculiarly susceptible to the influence of sound, and has no fundamental note of its own. It, therefore, transmits all audible sounds to the aural nerves without giving undue preponderance to any particular one.

IT is reported from Titusville, Pennsylvania, U.S., that the telephone will convey audible speech if it be applied to any part of the body of the speaker instead of to his lips. The sounds are fainter by this mode of operating, but quite distinct. A person may, therefore, transmit what he is saying by merely pressing a pocket telephone against his body.

IT has been suggested in America to apply the telephone to railway trains as a means of communication between driver and guard.

THE time occupied by a projectile in traversing its range is usually estimated by observing the flash and the moment of its fall to earth. In places where the flash cannot be observed the detonation may be as quickly heard by telephone.

IT is said that the Chinese are particularly well pleased with the telephone, and that messages have been sent in China over 500 miles of wire.

FROM a consideration of the recently observed facts that the telephone acts when the diaphragm of the receiving instrument is not only very thick and massive, but when it is non-magnetic, and even when there is no diaphragm at all, M. du Moncél argues that the articulate vibrations are principally produced in the magnetic bar itself, as the sounds were produced in the needle of Page's experiment. If this be true, the vibrating plate of the receiving telephone only strengthens, by reaction on the pole of the magnet, the magnetic effects determined in the interior of the latter by the undulatory current coming from the sending telephone. A diaphragm on the sending telephone is of course necessary to originate these currents under the influence of the voice. The lightness and flexibility of the receiving diaphragm are advantageous, because the magnetic variations due to the undulatory current will take place more rapidly in a plate of small mass, and the vibrations are for the same note of greater amplitude in a more flexible plate. In the sending telephone greater amplitude of vibration is attended by greater intensity of the induced currents transmitted; and in the receiving telephone the variations of magnetisation determining the sounds are rendered more sharp and definite; in both cases, therefore, there is an advantage in using a light flexible plate. As to the cause of the sounds emitted by the magnetic core, M. du Moncel thinks that they appear to be due to dilatations and contractions of the magnetic molecules, under the influence of successive magnetisations and demagnetisations.

MR. WM. F. CHANNING, in a letter to the *Journal of the Telegraph* (America), states that any common magneto-electric machine, arranged for giving shocks, makes an excellent telephone call—the sounds heard in a distant telephone having something of the character of a watchman's rattle, and being loud enough to be heard through adjoining rooms.

A COURSE of six lectures on electric telephony, by Mr. W. J. Wilson, F.C.S., M.S.T.E., will be delivered at the Birkbeck Literary and Scientific Institution, on Saturday evenings, commencing March 23. The syllabus includes an exposition of the elementary electrical apparatus involved; the mechanism of the ear; the nature of sound; phonographs, including Edison's; and the different kinds of telephones. The entire proceeds of these lectures will be given to the fund now being raised for the erection of a new building for the institution.

WE are told that Mr. Edison has constructed a clock which calls out the hours by phonograph, and adds appropriate remarks. The days of the cuckoo clocks are therefore numbered, if, indeed, they have not been so for a good many years, for we may now have clocks which will mimic any sounds whatever. The appropriate remarks which a clock might make are obviously of a very varied kind. The time-worn motto "*Tempus fugit*" would receive a new emphasis by being spoken to us, but we fear it would be as little heeded as before, although delivered in the most impressive and solemn manner. Then we might have "Go to the ant thou sluggard" ejaculated at a sufficiently early hour in the morning, and "Early to bed," &c., just suggested to us at bed-time, as well as many other wise saws and copy-book morals. There would be some danger, however, of a pragmatical clock of this kind becoming a bore, unless its observations were both varied and amusing; but this they could easily be. How convenient such a clock will be for society to administer its delicate hints to unwelcome visitors!

CRYSTALLISED MUSIC.—Not seldom have the poet lightly scattered from their teeming fancy, ideas which

ater ages of science have slowly made good in fact. In Shelley's *Witch of Atlas* occur the following lines:—

> The deep recesses of her odorous dwelling
> Were stored with magic treasures, sounds of air,
> Which had the power all spirits of compelling,
> Folded in cells of crystal silence there,
> Such as we hear in youth, and think the feeling
> Will never die—yet ere we are aware,
> The feeling and the sound are fled and gone,
> And the regret they leave remains alone.

Of course this poetic dream has been realised by the phonograph of Edison, who, happily, need not fear any claim of priority of invention on the part of the *Witch of Atlas*.

THE American "Keats" lock-stitch sewing machine, a new invention, is said to be able to sew through all kinds of sole leather and belting, and also to stitch leather to pine boarding.

LOCAL ELECTRICAL SOCIETIES are spreading in the United States. After the American Electrical Society which is representative of the whole country, there is the Chicago Electrical Society, now a large and flourishing body, and more recently in the cities of San Francisco, Cal., and in Cleveland and Toledo, Ohio, there have been started three other local societies. The members diversify the severer scientific business of the meetings by songs, music, and recitations. This evidence of a healthy *esprit de corps* amongst American electricians is quite refreshing.

A FREAK OF TELEGRAPHY.—On March 2, Reuter's Agency received the following telegram from Brisbane, Australia:—"Governor of Queensland, twins first son." Their official at once interpreted this into conventional English, and it appeared in the leading newspapers next morning as "Lady Kennedy has given birth to twins, the eldest being a son." This announcement was well calculated to surprise the friends of Sir Arthur Kennedy in England, who had reason to believe that he was unmarried, and on their suggesting to Reuter's that there must be some mistake, a repetition of the message was asked for. It was received a few days later, and ran thus:—"Governor of Queensland turns first sod." It appears that Governor Kennedy had been opening the works of the Maryborough-Gympic Railway.

THE steamers *John Pender* and *Chiltern*, left Malta, on Wednesday, March 13, with submarine cables on board, having been chartered by the Government to lay them at various points in the Levant.

TELEGRAPHIC COMMUNICATION WITH THE CAPE.—A meeting of South African merchants was held recently in the City, and resolutions were passed in favour of the establishment of a telegraph line to Cape Colony. Mr. Donald Currie occupied the chair. A committee was appointed to represent the views of the colonists to Sir Michael Hicks-Beach, and to press upon the Government the urgent necessity for the early laying of a line of cable to connect England and South Africa, leaving it to the Government to judge whether the cable should be laid on the east or west side of Africa.

THE Post Office authorities notify that the cable between England and France and the Channel Islands is interrupted. The English cable also being interrupted, messages can now only be despatched by steamer.

A DEAF-MUTE TELEGRAPHER. — Considering the fact that in telegraphy, as now practised, all messages are read from sound, and that on the quickness and good training of the ear depends, to a great extent, an operator's skill, one of the most remarkable cases (in fact the only one) on record in this or any other country was that of the late Samuel J. Hoffman. Having lost his hearing entirely a short time after learning telegraphy, he nevertheless continued the practice and successively occupied prominent positions as long as he lived. He made use of a sounder of his own construction, and received by placing his hand over it in such a manner that he could feel distinctly every vibration of the armature. He could thus continue to receive by the hour without "breaking," and experienced no difficulty except when the wire worked hard, or the circuit changed frequently; he obviated this by placing his fingers on the binding screws of the relay, distinguishing the characters by variations of the current. He died in Florida, having gained the reputation of being a most thorough operator and electrician.—*Scientific American.*

AN attempt is being made by a party in the Western Union Telegraph Company of America to obtain a repeal of the agreement entered into in August last between that Company and its great rival the Atlantic and Pacific Company to "pool" their joint receipts, the A. and P. getting 12½ per cent., and the W. U. the remainder. It appears that the latter company finds the expenditure of the A. and P. to be largely in excess of its receipts, so that under terms of its agreement the W. U. was obliged in the first three months of the amalgamation to pay out to the A. and P. an aggregate of 120,000 dollars. Application has been made by Elias C. Benedict (who claims to own a hundred shares of W. U. stock, and is known as a warm partisan of that company) and other shareholders for a perpetual injunction, restraining the W. U. from carrying out the provisions of their recent agreement with the A. and P. This was granted for twenty days in the meantime; the defendants being ordered to show cause why the restriction should not be made permanent. The suit causes a great deal of interest in the United States.

THE State of Pennsylvania, U.S., insists upon the forfeiture of the charters of the Western Union Telegraph Company by reason of its consolidation with the A. and P.

"THE New York Legislature," says the *Operator*, "after putting the W. U. Company to great expense to prevent the passing of an act requiring the running of wires underground through cities, now comes forward with another source of annoyance in the shape of a bill substituting iron telegraph poles in cities in place of the present wooden ones."

A BILL has been introduced into the legislature of the state of Wisconsin, U.S., which requires that any telegraph company doing business in that state shall report to the State Treasurer on or before the 1st of April of each year the amount of its gross receipts, on which it shall be called upon to pay a tax of four per cent. The bill also limits the message tariffs and otherwise interferes, a penalty of 5,000 dollars being imposed in case of non-compliance with the law. It is expected to be bitterly opposed by the telegraph companies which it affects.

A NEW American telegraph company to be called the "States Union Telegraph Company" has been organized in Boston. The capital is ten million dollars, and its object is to construct lines between all the large cities of the United States.

A TELEGRAM from Berne, dated March 21, states definitely that the Argentine Confederation will be admitted into the International Telegraph Union on April 1.

THE ACCUMULATION BY REACTION PRINCIPLE OF DYNAMO-ELECTRIC MACHINES has been the subject of a recent controversy in the columns of one of our contemporaries. From this discussion it appears that the principle of accumulating electricity in magneto-electric machines by causing the electricity excited in the revolving armature in turn to intensify the exciting electro-magnets has been almost simultaneously applied by Dr. Werner Siemens, Professor Wheatstone, and Mr. S. A. Varley. Mr. Robert Sabine has summed up the respective claims of these gentlemen in the following words: "The date when an undefined idea of making any machine first occurs to an inventor is of very little comparative importance, unless the idea be productive of some evidence of its being, without which one would naturally be inclined to suspect that memory might after the lapse of years be a little treacherous. Who had the first happy inspiration of a reaction machine we can scarcely expect to know now. Of its fruits we have better evidence, and I venture to think that the claims of the three inventors in question stand thus:—Professor Wheatstone was the first to complete and try the reaction machine; Mr. S. A. Varley was the first to put the machine officially on record in a provisional specification dated Dec. 24, 1866, which was therefore not published till July, 1867; Dr. Werner Siemens was the first to call public attention to the machine in a paper read before the Berlin Academy on the 17th of January, 1867." In connection with this subject our attention has been called to a forgotten English patent, No. 2198, of the year 1854, and in the name of Sören Hjorth, Copenhagen. This patent clearly sets forth the mutual accumulation principle of magneto-electric machines as will be seen from the following extract:—"The main feature of this battery consists in applying one, two, or several permanent magnets of cast iron, and shaped as shewn, in connection with an equal number or more electro-magnets, shaped as indicated in drawing, in such a manner that the currents induced in the coils of the revolving armatures are allowed to pass round the electro-magnets; consequently, the more the electro-magnets are excited in the said manner, the more will the armatures be excited, and more electricity of course induced in the respective coilings; and while a mutual and accelerating force is thus produced in this manner between the electro-magnets and the armatures, an additional or secondary current is at the same time induced in the coiling of the electro-magnets by the motion of the armatures, the said current flowing in the same direction as that of the primary current after having passed the commutator." This important patent received provisional protection only, because notice to proceed was not given in the time prescribed by the Act.

INFLUENCE of ELECTRICITY ON EVAPORATION.—M. Mascart has just communicated the results of his experiments on this subject to the French Academy of Sciences. Since atmospheric electricity has been known to exist, it has been supposed to owe its origin chiefly to the evaporation of water, and the experiments of Pouillet seemed to prove this supposition to be true. But more recent researches have cast doubts upon it. It was observed that in all the cases of violent ebullition in which electricity was developed by evaporation, there was always to be found small grains of solid matter projected upon the walls of the vessel; and these appear to have played an important part in the production of electricity, for, when care was taken entirely to exclude them, no electricity was produced. Again, the quantity of electricity furnished by gentle evaporation, was very feeble and inappreciable. M. Mascart's experiments had an opposite aim. They were intended to determine if electrification modified the evaporation of water. Accordingly, he arranged a set of small basins, containing water, or moist earth, under the conductors of a Holtz electrical machine, maintained at a high and constant potential. The basins themselves were connected to earth, as also were the other poles of the machine. The electrified conductors over the basin were in the form of a grating, which did not check evaporation, and were supported about 2 centimetres

over the evaporating surface. The quantity of water evaporated by each basin was determined daily. M. Mascart found that electrification of the conductors accelerated the rate of evaporation whatever the sign of the electricity, and in some cases it doubled the rate. He also found, however, that slight variations of temperature completely masked the electric influence, and concordant results could only be obtained in a closed box regularly dried and kept in a cellar, where the temperature only varied form 4° to 6° during nearly a month. M. Mascart did not clearly determine the rates of evaporation under positive and negative charges; but he continues his experiments. However this curious effect of electricity be brought about, it seems to be appreciable only under very high charges. In connection with it, we may refer to the experiments of Mr. Cassamajor on the motions of camphor in electrified water, see TELEGRAPHIC JOURNAL, Dec. 15, 1877.

THE HOWE SEWING-MACHINE ELECTRO-MOTOR.—Any day in Queen Victoria Street, City, this tiny electro-motor may be seen busily at work plying the stout needle of a Howe sewing-machine at the rate of 500 stitches a minute. It is perched upon the corner of the table of the machine and is actuated by 3 large double plated Grove cells. It consists of a cross shaped electro-magnetic armature, revolving on an axle, which carries the driving pulley. This armature rotates in the inter-polar space formed by five bar electro-magnets, set radially with respect to each other and to the armature. The outer poles of these magnets are united by an armature of soft iron, which also forms the outer protecting case of the motor. The current magnetises both armature and electro-magnets, and it is made and unmade by a commutator so as to pull forward each arm of the cross-shaped armature one after another with the least possible "dead point" in the rotation. The motor is in the form of a short cylinder, some 6 inches in diameter, and 7 inches long, and weighs only 16 lbs. All the iron employed is cast. The resistance of the circuit is about $\frac{3}{4}$ ohms. Three Grove or Bunsen cells drive it for 30 hours without changing the solutions; but as there are objections to the acid fumes of these batteries in a house, it would be an advantage to be able to replace them by some less obnoxious kind, which would be equally powerful and constant. A special feature of the motor is the poles of the electro-magnets and armatures, which are serrated like the teeth of a saw so that as the armature passes a pole its teeth coincide with the gaps between the teeth of the pole. This form is held to concentrate the magnetic power.

CURRENTS IN LIQUIDS.—M. Herwig has been continuing his researches on the passage of currents through liquids. He finds that they do not strictly obey Ohm's law, there being at first contact a retardation of the current, which when it does set in, resembles the discharge from a condenser. See *Ann. der Physik*, No. 12.

CAPACITY OF ELECTROLYTES.—The following results are taken from a paper by M. Herwig, in *Ann. der Phys.*, II., p. 556: It is well known that when a current of sufficient strength to decompose it is passed through a liquid electrolyte the current gradually diminishes in strength until it becomes very feeble; and if the current be then interrupted a current in the opposite direction will be set up. The effect is analogous to that produced when a condenser is substituted for the electrolyte. Assuming that the electrolyte under such condition behaves like a condenser of capacity c, and the resistance of which is $\frac{1}{w}$, the intensity of the first changing current will be a function $i=i\left(_{\infty}{}_{1+ke}{}^{-at}\right)$ of the time and the current of discharge will be another function $i^1=i_0\, e^{-at}$. In these two expressions the factor a is the same, and equal to $\frac{1}{c}\left(\frac{1}{R}+\frac{1}{w}\right)$, R being the resistance of the circuit external to the liquid. By measuring with a galvanometer the values of i and i^1 at different instants, we can then obtain the quantity a, and, as w can be deduced from the intensity towards which the discharging current tends, we can calculate c.

In this way, c is found for the same experiment to have very different values (in the ratio of 1 to 10), increasing with the time, as well for the current of charge as for that of discharge. The resistance w has otherwise nothing in common with the resistance that the same liquid presents when traversed by a current strong enough to decompose it; (in an experiment where the latter resistance was 6 ohms, w was found to be = 1,031 ohms). For the rest, w does not obey Ohm's law, and increases much less rapidly than the resistance of the platinum plates serving for electrodes; it even varies when the direction of charge is changed.

ELECTROLYSIS OF DILUTE SULPHURIC ACID.—It was observed by Faraday that the dilute sulphuric acid under electrolysis yielded a volume of oxygen less than one-half that of the hydrogen simultaneously disengaged, and attributed the deficit to the formation of hydrogenated water. M. Berthelot is of opinion that it cannot be oxygenated water which is formed nor even ozone. It is, he says, only formed during the electrolysis of sulphuric solutions, and is therefore likely to be persulphuric acid.

THE ACTION OF THE COPPER-ZINC COUPLE ON OXY-SALTS. — Dr. Gladstone and Mr. Tribe have recently been investigating this subject and have communicated a paper upon it to the Chemical Society. In 1873 it was proved by Prof. Thorpe that the copper-zinc couple converts the nitrogen of nitre in presence of water into ammonia. It had been previously observed, however, by Messrs. Gladstone and Tribe that nitrates were first formed, and they have studied the reaction completely. The chemical change is a

very variable one. At the beginning, ammonia and its equivalent of potash are made in increasing quantities until the time when the maximum amount of nitrite is produced; after which the rate of production of the alkalies rapidly increases and the supply of nitrites falls off. Solutions of ammonia containing 0·026 and 0·256 per cent. increase the action of the couple, but stronger solutions diminish it. Solutions of potash from 0·08 to 60 per cent. increase its action. The explanation of the change advanced by Messrs. Gladstone and Tribe is that the copper and zinc electrolise the nitre with the formation of nitrate of zinc, the nitre being reduced at the negative pole through the agency of the potassium. The copper-zinc couple also converts the potassium chlorate into potassium chloride, but no chlorites or hypochlorites are then formed. The net results arrived at by the authors are:—1. The action of the copper-zinc couple on these oxy-salts is of an electrolytic nature. 2. The negative radical combines with the zinc whilst the positive radical or its equivalent of hydrogen from decomposed water is set free against copper crystals. 3. The salt is reduced and hydrogenised in the vicinity of the negative metal; and it is probable that hydrogen is set free against the copper, but is condensed by the finely divided metal, and in that condition reduces and hydrogenises. The couple acts in the same way on ammonium nitrite.

Patents.

844. "A new mode of conveying sound from vibrating and sound producing or receiving bodies."—E. C. WALKER, March 2.

861. "Apparatus for the production of light by electricity."—T. F. SCOTT, March 2.

915. "An improved method of and apparatus for transmitting power by electric currents."—H. C. SPALDING, March 6.

929. "Electric lamp lighting apparatus." — P. DRONIER, March 7.

953. "Electro-magnetic machines."—J. H. JOHNSON (communicated by Z. T. Gramme and E. L. d'Ivernois), March 9.

ABSTRACTS OF SPECIFICATIONS.

1693. "Expansion and contraction coupling for signal and telegraph wires."—G. PICKERSGILL. Dated May 1, 1877. 2d. The wire of semaphores being liable to change in length, according to temperature, this consists in means for allowing them to do so, always preserving the proper degree of tightness in the wire. A metal tube or cylinder contains one or more piston-rods, fitted with rings or discs of india rubber, within the tube. The piston-rods, after passing through the covers on the ends of the tube, are attached to the wire. *(Not proceeded with.)*

1702. "Producing and recording electric signals."—F. H. VARLEY. Dated May 2, 1877. 6d. This consists in improvements in the battery key and receiver of a telegraphic circuit. The battery described is the carbon and oxide of maganese battery, with provision for keeping mercury round the zinc, so that it be constantly amalgamated; dilute sulphuric acid being preferred as the exciting liquid. A transmitter for railway signalling is also described. It is formed of a vertical axis to which is joined a reversable handle, or a swing tablet showing on one side "line blocked" and on the other "line clear": this tablet, when pressed, signals to the receiving station the announcement corresponding to the direction in which the tablet has been turned. The electro-magnetic receiver is so constructed that the needle is permanently deflected even after the deflecting current has stopped, until it be freed by the reversal of the current. It is made of a double frame of iron to which are connected electro-magnets. An induced magnetic needle turns freely between them. These frames are employed as conductors of magnetism to maintain the direction of magnetism in the indicating needle, whilst the current passing through the coils shifts the plane of magnetic attraction from one portion of the frame to the other, causing the needle to be held over in the direction of attraction, or liberated and reversed in position by a reverse current through the coils.

1829. "Electro-magnetic apparatus for developing motive power."—RICHARD WERDERMANN. Dated May 10, 1877. 6d. A conical armature of soft iron is hinged at one end of its axis on a universal joint so that it is free to oscillate in such a manner that the axis describes a cone. This peculiar oscillation or rocking is produced in order to allow the free end of the perpendicular or axis of the cone to rotate an axle by means of a short crank. It is effected by flattening out the edge or base of the cone into a disc, which is made to rotate and oscillate, in short to wobble, by a series of electro-magnets on each side of it, the magnets being made and unmade at the proper time. A full account of the arrangement is given in the TELEGRAPHIC JOURNAL for January 15th.

1871. "Recording electric telegraph signals."—C. H. SIEMENS. Dated May 14, 1877. 6d. This consists in a recorder formed of an aluminium coil moving in a magnetic field and deflecting to and fro according to the kind of current passed through the coil. A fine marking point connected to the coil traces the motions of the latter on a moving surface of smoked paper. A full account of the arrangement is given in the TELEGRAPHIC JOURNAL for March 1, 1878.

2064. "Skating or bicycling."—H. HORSTMAN. Dated May 26, 1877. 6d. This consists in a plan for enabling a person to skate or ride a bicycle on certain lines of rail of special construction, and of applying electro-magnetic motive power to drive the skates or bicycle. Magnetism may not only be used to propel the skates but to cause them to adhere to the rails.

Correspondence.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—It may perhaps interest some of the readers of your valuable journal to know that they can double the volume of sound coming from the telephone by a very simple addition to it. My experiment was as follows:—To the back of the head of a telephone, immediately behind the disc, I attached a foot of half-inch flexible tubing, and to the end of the tubing,

remote from the telephone was attached a turned wood cone large enough to cover the ear. On applying the telephone to one ear and the cone to the other the vibration of the plate was given off to both ears from the same telephone, the sound being doubled thereby. Accept my apologies for intruding on your valuable space, and believe me,

Yours obediently,
FREDERICK JOHN SMITH.

Mary Street House, Taunton.
March, 23, 1878.

Proceedings of Societies.

SOCIETY OF TELEGRAPH ENGINEERS.

AT the ordinary general meeting held on the 27th February, a large audience assembled in consequence of the varied and attractive programme which had been issued, the chief feature of interest being Mr. W. H. Preece's explanation of the Phonograph.

(1.) The business of the evening commenced with a communication from Dr. Muirhead, supplemented by explanatory remarks from Mr. Latimer Clark, on the chloride of silver cell of Mr. Warren de la Rue. This cell was first described by Mr. de la Rue before the Society of Telegraph Engineers on the 28th April, 1875, and again in a joint communication by MM. de la Rue, Müller and Spottiswoode, to the Royal Society (Proc. R. S. No. 160, 1875); an illustration of it has recently appeared in this journal. It consists of a tabular glass vessel 4 or 5 inches high, and about 1 inch in diameter, closed by a stopper of cork or paraffin wax. Through the stopper pass two silver wires, one of which has a cylinder of silver chloride cast on it, the other being attached to a small cylinder of pure zinc. The chloride cylinder is loosely cased in with a tube of parchment paper, and the vessel is nearly filled with a solution made by dissolving from 20 to 25 grammes of sodium chloride, zinc chloride or (preferably) ammonium chloride, in one litre of pure water (say 1750 grains to the gallon). The electro-motive force is about 1·06 volt, and its resistance 2 or 3 ohms, according to the distance between the zinc and chloride. A preliminary investigation of the qualities of this cell has been made at Mr. Clark's request by Dr. Muirhead, and the following figures show the result of comparison of 60 cells. One cell was chosen as the standard, and was found to give a shunted deflection representing a full deflection of 346,730 divisions through a Thomson galvanometer of 5,220 ohms resistance. Each of the other cells was then joined up, in opposition to the standard and the following deflections were obtained:—

0	260
45	200
+45	110
180	280
130	260
210	250
0	250
170	210
170	130
165	230
130	150
190	+310
120	120
50	140
20	90
310	60
250	+250
175	0
380	+215
130	100
180	430
270	120
175	380
100	150
290	280
270	+70
110	+20
220	75
130	10
220	

All those not otherwise marked are *minus*. The maximum difference thus observed was 1-80th of the standard cell.

It is claimed for this cell, that the electro-motive force remains very constant for long periods, and that it is not affected by shaking. These qualities together with the small size of the cells, render them eminently suitable for testing purposes, especially on board ship.

The first cost is about one shilling per cell, exclusive of the silver chloride which costs about two shillings per cell. The action of the cell is to reduce pure silver, and this can be reconverted into chloride at a small cost.

(2.) The second subject dealt with was Dr. Byrne's Pneumatic Battery, exhibited by Mr. H. Edmunds and described by Mr. Preece. This battery is a peculiar modification of the bichromate of potash battery. The positive plate is of zinc as usual; the negative plate is a compound one of lead, copper, and platinum. The solution is made in the proportion of 12 oz. potassium bichromate to 1 pint of sulphuric acid and 5 pints of water. When the battery is in action, air is forced into and through the solution by means of a bellows, communicating with a perforated tube inside the cells, a most remarkable rise in the current strength being the result.

With the ten cells exhibited by Mr. Edmunds, a 30 in. length of No. 14 platinum wire was raised to incandescence, and the stout copper electrodes were also sensibly heated. The internal resistance of this cell is so small that Mr. Preece had been unable to measure it with the apparatus at his command.

The great increase in the strength of the current which follows the pumping does not readily admit of explanation, and seems to call for further experiment. Mr. Ladd, the maker of the cells exhibited, stated that he had pumped in successively air, oxygen, and hydrogen, but without observing any difference in the result. He therefore concluded that the effect was principally a mechanical one; but he also attributed some of the success of this battery to low resistance of the negative plate. Mr. Edmunds stated that Dr. Byrne also considered the efficacy of the cell due in great measure to the compound plate, as he had obtained remarkable results even without the pumping, employing a solution of sulphuric acid only. Dr. Byrne further considered the effect of the pumping to be a depolarisation of the plates. Mr. Preece's experiments appeared to give a verdict at variance with some of these opinions. He had found the electro-motive force to be the same when the battery was quiescent, as when the pumping was going on, viz., about 1·7 volt. It was suggested by Professor Adams that the circulation of the liquid, caused by the influx of air, continually brought fresh acid into contact with the zinc plate and thus gave rise to the enhanced current. Mr. Preece, however, pointed out that if this were the case, the effect ought to be instantaneous or nearly so, whereas it was observed that the increase of current strength was gradual, as was also

the diminution on stopping the pumping. It was also noticed that a great amount of heat was generated within the cell itself, and this has been variously attributed to the diminution of internal resistance, and to the increased chemical action going on in the cell.

(3.) Mr. W. H. Barlow, F.R.S., M.I.C.E., next exhibited his "logograph," an instrument designed by him about four years ago with a view to making it an automatic short-hand writer, a result not yet attained. A trumpet-shaped mouthpiece is closed at the smaller end by a thin india-rubber diaphragm about 2¼ in. in diameter, which carries a fine camel-hair pencil moistened with an aniline ink. A strip of Morse paper is drawn past the pencil by clockwork. On speaking into the mouthpiece the diaphragm is set in vibration and agitates the pencil which thus describes fine curves on the paper slip closely resembling those produced by Thomson's "Siphon Recorder." These curves are the graphic representation of the sounds uttered, and are produced directly by the mechanical impulse of the puffs of air sent out in uttering them. Repetitions of the same word or sound gave almost exactly similar curves, the consonants usually giving evidence of a much more violent agitation than the vowels. Slight disturbances however were noticeable which would materially increase the difficulty of reading, but it is not improbable that further improvements in the machine may enable a practised eye to decipher the words represented by these curves with as much ease as telegraphic signals can be read.

(4.) The last and most eagerly looked for item of the evening was the description by Mr. Preece of the phonograph, recently invented by Mr. Thomas Alva Edison, of New York. This instrument, which has been lately described in these pages, consists essentially of a rotating cylinder or drum, and a vibrating diaphragm carrying a point which produces indentations on a sheet of tinfoil carried by the drum. The drum, which is of brass, has a groove cut on its surface spirally from end to end, and is fixed on a screwed axle of the same pitch, turning in a screwed bearing, so that a motion of rotation is accompanied by a lateral traverse. A mouthpiece closed by a metal diaphragm is fixed on a stand, which can be moved by an adjusting screw in a direction at right angles to the drum. The centre of the diaphragm carries a small steel pointer; and over the surface of the cylinder is laid a sheet of tinfoil. On speaking or singing into the mouthpiece, the cylinder being at the same time rotated, the diaphragm is thrown into vibration, and these vibrations cause the steel pointer to impress greater or less indentions upon the tinfoil in a line coincident with the spiral groove. Three instruments were exhibited, viz., one sent over by Mr. Edison, a second made for experimental purposes by Mr. Pidgeon, a London gentleman, and a third constructed by Mr. A. Stroh, the well-known mechanician of London. In each of the two former, the axle was provided with a fly-wheel, to give a more uniform motion than could be obtained with the unaided hand; in the third, however, a much more uniform motion was attained by driving the cylinder by clockwork, to which an ingenious governor was applied to regulate the speed.

To reproduce the sounds it is only necessary to remove the mouthpiece a short distance, shift back the cylinder, and again bring up the diaphragm so that the pin presses lightly on the foil. The cylinder being now turned, the pointer retraces its steps, and imparts to the diaphragm vibrations which are the counterpart of the original ones. In the original instrument, made by Mr. Edison, as also in that made by Mr. Pidgeon, a separate diaphragm of paper is used for reproducing the sounds, the diaphragm being attached by a silk thread to a light spring, armed with a point, and pressing on the cylinder.

Mr. Preece's discourse was illustrated by practical experiments, which produced much merriment and a profound sensation; and a cordial vote of thanks was passed to Mr. Edison, to his representative, Mr. Puskas, to Mr. Pidgeon, and to Mr. Stroh.

At the ordinary general meetings held on the 13th and 27th ults., a paper by Mr. J. Gavey on "Insulators for Aërial Telegraph Lines" was read and discussed. As the subject embraced the whole history of insulators concerning which some new facts were elicited, we are compelled to postpone our remarks to our next issue.

THE INSTITUTION OF CIVIL ENGINEERS.

AT the meeting on Tuesday, the 12th of March, Mr. BATEMAN, President, in the chair, the Paper read was "On Railway Appliances at the Philadelphia Exhibition of 1876," by Mr. Douglas Galton, C.B., F.R.S., Assoc. Inst. C.E.

The first American railroad was constructed in 1830, and about 22,000 miles were in operation in 1856, and 74,600 miles in 1875. In America the railway is the pioneer road, and frequently the sole means of communication. The object has accordingly been to make the lines as cheaply as possible in the first instances; and considerable expense has been subsequently incurred in perfecting the lines.

The subject was treated under the following heads: I. Permanent Way; II. Cars and Car Fittings; III. Locomotive Engines; IV. Railroads of 3-feet Gauge.

The main features of the standard track of the Pennsylvanian Railroad Company consisted in the shape of the head of the rail; the form of splice for the joints; the large number of sleepers, and the arrangement of the ballast. The splices were two feet in length. The outside splice had a tongue which passed over the flange of the rail and was spiked to the sleepers. The joint was suspended midway between two sleepers.

The weights per wheel in the heaviest engines were about 4½ tons. In connection with the permanent way, attention was directed to the Wharton switch, the principle of which was to carry the train off the main line on to a siding, without any break in the continuity of the main line rails.

The great distances on American lines had led to the conversion of the passenger cars into travelling hotels. The main advantage of the American form of car, which consisted of a long body supported at each end on a bogie truck, was the power of movement afforded to the passengers, and of access to conveniences. The disadvantages were, the mode of opening the windows, which slid up instead of being let down into the panels, and the difficulty of ventilation, but the latter had been overcome by a central raised roof with clerestory windows.

The use of chilled cast-iron wheels was all but universal on American railroads. Each wheel formed a single casting with the tire, and was cast in a chill, consisting of a rim of iron turned perfectly true, so that labour in turning was avoided. The necessary hardness in the chill was obtained by a mixture of charcoal iron, chiefly Salisbury iron, with broken up wheels and castings. The comparatively high price of charcoal iron had led to the substitution for it, in part, of anthracite iron, with wrought iron or Bessemer steel.

The duration of car-wheels in the United States was stated to be from 50,000 to 60,000 miles. They could then be turned up and run a further mileage. Good chilled cast-iron wheels were economical; and provided they were periodically examined, they did not appear to break so as to cause accidents.

The brakes on American railroads were, as a rule,

capable of being applied to a larger number of wheels in a train than in this country. This had probably arisen from the greater necessity for the rapid stopping of trains, owing to the absence of secure fencing and the prevalence of single lines. It seemed to be recognized in the United States, 1st, that the engine-driver should have complete control over the application of brake-power to all the wheels of the train; and 2ndly, that in the case of the accidental fracture of the couplings, the detached cars should be at once brought to rest by the action of the brakes attached to them. The Westinghouse automatic air brake was in extensive use on American railroads, especially for passenger trains. In it the air in the pipes was pumped in continually under pressure, and the brakes were applied by diminution of pressure. Smith's vacuum brake (the property of the Westinghouse Brake Company) was occasionally employed, where rapidity of action was not of paramount importance. It was less expensive, and its action was dependent on a vacuum in the pipe.

The striking fact gathered from the exhibition of railroad cars at Philadelphia was that, while the comfort of railway travelling had been practically stationary in Europe for the last twenty-five years, it had been rapidly developed in the United States within the last few years to a standard above that of Europe. The comforts were as much needed in Europe. The distances were as great; the cold was as intense; the populations to be accommodated were as numerous, and more wealthy. No doubt the control exercised by Continential Governments had had some effect in stopping improvements; but the Author believed the stagnation was largely due to the use of small carriages divided into compartments. These had actually prevented the development of comfort, while the larger American car had both suggested and afforded scope for improvement. Until European Railway Companies followed the lead of America, and adopted long carriages on bogie trucks, comfort in travelling would remain in its present unsatisfactory condition.

Locomotive engines in the United States were of a totally different type to those in Europe. The front part of the engine was supported on a bogie truck, by which a short wheel base was possible. This truck was generally so arranged that the pivot was under the centre of the smoke-box, and the front wheels were considerably in advance of the body of the engine. When a bogie truck was not used, the front of the engine was carried (except in the case of a few special engines for inclines or for switching), by a Bissel two-wheeled "pony" truck, which had a swing bolster and a radius bar pivoting from a point about 4 feet behind the centre of the truck, the weight being equalised between the pony truck and the leading pair of driving wheels.

Within the last few years companies had been formed to construct in America 8,000 miles of narrow-gauge lines, of which 2,700 miles were in operation at the beginning of 1877.

The Denver and Rio Grande Railroad was proposed to be 1,700 miles long, and between 200 and 300 miles had been completed. The promoters of this system contended that a mile of single line having a gauge of 3 feet could be made for £1,904, with rails weighing 30lbs. to the yard, or for £2,144, with rails of 40lbs. to the yard, while the rolling stock might cost £758 per mile, calculated for a length of 100 miles of road.

It was worthy of consideration whether, in the colonies, narrow-gauge railways of cheaper construction, and with cheaper rolling-stock than the ordinary gauge might not be advantageously adopted, and amply suffice for the wants of such communities.

In the discussion which followed, and which was continued at the meeting on the 19th of March, the differences between railway practice in the United States and this country, with reference chiefly to wheels and forms of carriages, were dwelt upon. The use of chilled steel tires in America was contrasted with that of wrought iron tires here.

The advantages of the American cars were upheld by some speakers as affording greater comfort, whilst Mr. Ashbury, Mr. Bramwell, and the president, considered that the English system of numerous compartments enabled passengers to travel with less disturbance, and pointed to the fact that persons always sought for a compartment with fewest passengers. Mr. Bramwell even regarded the old stage coach principle of only four inside passengers as the best, as the fewer one's fellow passengers the less chance of an objectionable person or a bore, and the fewer persons a casual bore could annoy. Mr. Ashbury pointed out that the number of doors was an advantage possessed by the English system, and mentioned the Metropolitan Railway as an instance of a line on which the American cars could not be used, with their small accommodation for ingress and egress. Mr. Finlay thought that railway companies in England had fully consulted the convenience of passengers, and that for long night journeys, as much comfort was attainable as on the American cars; and he observed that the day saloon cars on the Midland Railway were not popular.

It was remarked that the advantages possessed by American locomotives were sufficiently demonstrated by the fact that, in spite of the distance, the locomotives supplied to St. Petersburg are now procured from America.

Captain Galton, in reply, said that he had been led to offer this paper by a remark of Sir John Hawkshaw, that much might be learnt by English engineers from American practice. He considered that the system of large cars was chiefly applicable to continental countries, where the journeys resembled in length those in the United States. He thought that if, instead of the old stage coach type, the plan of the steamboat saloon had been imitated for railway carriages in the first introduction of railways, more comforts during the journey would have been attainable, and fewer appliances at stations would have been required.

PHYSICAL SOCIETY.—MARCH 16th, 1878.

Prof. W. G. ADAMS, President, in the chair.

A Special General Meeting was held for the election of an *ex-officio* honorary member of the Physical Society of Paris.

The following candidates were then elected members of the Society:—J. S. Bergheim, W. M. Hicks, M.A., Dr. J. Hopkinson, M.A., D.Sc., Miss E. Prance, and T. Wills.

The SECRETARY read a paper by Mr. W. J. Millar, C.E., "On the Transmission of Vocal and other Sounds by Wires." The author was led mainly by a consideration of the manner in which sounds are conveyed through walls and partitions, to make an extensive series of experiments on this subject, from which he concludes that conversation can be carried on at considerable distances by simply employing stretched wires provided with suitable vibrating discs. In one experiment, two copper wires were attached to points on a telegraph wire 150 yards apart, and breathing, singing, &c., were distinctly audible; by stretched wires, extending through a house, and provided with mouth and ear pieces in the several rooms, conversation could be carried on without difficulty. The materials employed for terminals were very varied, and the vibrating disc, whether metal, wood, or india-rubber, &c., was generally formed as a drum head, the wire being fastened at its centre. The volume of

sound appears to be greater with a heavy wire, but in all cases it requires to be stretched.

The PRESIDENT referred to the experiments of Wheatstone on the conduction of sound by solid bodies, especially long wooden rods. Some years ago, M. Cornu, in conjunction with M. Mercadier, made experiments which showed that vibrations can be transmitted along a copper wire, and rendered visible at the distant end on a rotating blackened drum. The free end of the wire was attached to a piece of copperfoil fixed at its base and provided with a point, which left a clear trace on the drum when the distant end was attached to, say, a vibrating tuning fork.

Mr. W. H. PREECE described some experiments made in September of last year by Mr. A. W. Heaviside and Mr. Nixon at Newcastle-on-Tyne on this subject. They find that a No. 4 wire gives the best results. The terminals were wooden discs, about one-eighth inch thick, and to these the wire was attached "end on," but speech could be distinctly heard by laying such a disc on any intermediate point of the wire. When the wire was particularly still, speech was audible up to 200 yards.

Mr. G. W. VON TUNZELMANN then read a paper on the "Production of Thermo-electric Currents in Wires subjected to Mechanical Strain." The wire, of iron, steel or copper, was stretched vertically between two cans, which could be maintained at different temperatures: it was fixed in the base of the lower can, and held in the upper one by a clamp attached to the shorter arm of a lever, to the longer arm of which the stretching weight was applied. The free ends of the wire were joined to copper wires which led to the Thomson galvanometer, these junctions being covered with cotton wool. He has succeeded in reconciling the contradictory conclusions arrived at by Sir W. Thomson and M. Le Roux, for, whereas the former only used moderate strains, the latter worked near the breaking limit, and the author finds that if the weight be gradually increased the direction of the current changes, and hence these two authorities found the currents to flow in opposite directions. A great number of experiments were made, and from them it is evident that on applying a strain the deflection does not immediately attain a maximum, but it gradually rises for about eight minutes and then gradually falls, attaining a stationary point at the end of about twelve minutes.

Professor ADAMS then exhibited a simple arrangement for projecting Lissajous' figures on to the screen which has been made by his assistant Mr. Furze.

Dr. GUTHRIE exhibited an experiment to show the behaviour of colloids and crystalloids in relation to electrolysis.

THE METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this society was held on Wednesday, the 20th instant, at the Institution of Civil Engineers; Mr. C. Greaves, President, in the chair. Mr. B. C. Smith was elected a Fellow. The discussion on Dr. Tripe's paper "On the Winter Climate of some English Sea-side Health Resorts" was resumed and concluded, after which the following papers were read:—"Notes on a Waterspout," by Captain W. Watson, F.M.S.; "Notes on the Occurrence of Globular Lightning and of Waterspouts in Co. Donegal, Ireland," by M. Fitzgerald; and "Observations of Rainfall at Sea," by W. T. Black.

The discussion on the subject of waterspouts and globular lightning was adjourned till the next meeting on April 17th.

General Science Columns.

MINUTES OF PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS, SESSION 1876-77. PART IV.

THE paper at the commencement of this volume, by Mr. Souttar, contains a full account of the methods of laying down tramways, the different kinds of foundation sleepers and rails employed, and the advantages or disadvantages of each. The preference is given to a concrete bed, if sufficient time for setting is allowed, if not, and the layer is thin, bituminous concrete is best. A longitudinal timber sleeper affords the smoothest road, and, with proper care, will last as long as the rail. Hard stone answers best for the paving between the rails, as wood and asphalt wear at the edges, and the rails become loose, and a macadamised road is difficult to maintain in such a narrow space. Till 1872 traction by steam was practically prohibited, as the rate of speed in towns was limited to two miles an hour. In that year, a select committee of the House of Commons recommended that locomotive carriages, under 6 tons, and consuming their own smoke, should be allowed to travel at the ordinary rate of vehicles drawn by horses. Tramway engines have been designed both separate from the passenger car, and combined with it. The former are to be preferred where steam is used, as the cleaning and repairing of the engine would damage a car attached to it, and any injury to the engine would cause the car to lie idle. Where compressed air is the motive power, the machinery is simpler, and there is not the same objection to the combination of engine and car. Mechanical motive power is estimated at almost 5d. per mile, and horse traction at 8½d.

Tramways have not found such favour in the metropolis and its suburbs, as in many provincial towns. Glasgow and Leeds, for instance, have tramways in some of their principal thoroughfares, and extending to the outskirts. The extension of tramways in London along the principal omnibus routes would be a great boon to the general public, but would probably not be welcomed by the owners of private carriages. The advantage of a tramway is that a person can be deposited at the point on the route nearest to his destination, and the journey, moreover, is performed with more regularity, and with far greater comfort than in most hired vehicles.

Sir William Armstrong in his paper entitled "The History of the Modern Development of Water-pressure Machinery" gives an interesting sketch of the circumstances which directed his attention to the utilisation of water-pressure, and the successive steps by which hydraulic machinery has been brought to its present state of perfection. The fall of water in some small streams, through steep valleys in Yorkshire, first suggested to him the idea of using water-pressure by

bringing down water in pipes from a high level. He first designed a machine combining the use of pistons with the continuous rotation of a water-wheel. He next designed a crane worked by water-pressure acting on pistons which proved very suitable for lifting heavy weights, the motion of the crane being under perfect control; and in 1846, hydraulic cranes were adopted by Mr. Hartley for the Albert Dock at Liverpool. Sir W. Armstrong, who had up to this time been a solicitor, gave up the law, and devoted himself to the improvement of hydraulic machinery. In the first instances the pressure obtained from the pipes of the water companies had been used, but in 1849, some hydraulic machinery having to be erected where the pressure thus obtained would have been insufficient, an air vessel was employed for furnishing the requisite pressure. The air vessel proved inconvenient, so high reservoir tanks were put up at Great Grimsby Docks in 1851, on the introduction of hydraulic engines for opening and closing the sluices and gates, and for working the cranes. The next improvement was the invention of the "Accumulator" as an economical substitute for a high reservoir tank. We referred in the last number to this appliance, as well as to the uses and advantages of hydraulic machinery, so we need only mention that amongst the numerous applications of this system not the least valuable has been its employment for moving the heavy guns with which the name of Sir W. Armstrong is so honourably connected.

A paper "On Foundations," by Professor Gaudard of Lausanne, appears in this volume which contains a very complete record of the various methods adopted in constructing bridge foundations.

EDDYSTONE LIGHTHOUSE. — The first lighthouse built on the Eddystone rocks in 1670, was destroyed in a violent storm in 1703. The second, erected in 1706, was destroyed by fire in 1755. The third exhibited its light for the first time on October 16th, 1759, and it was hoped till recently that this lighthouse would stand for ages, as a lasting monument of Smeaton's skill. The sea, however, unable by direct assault to overthrow the structure, has undermined it by disintegrating the rock on which it stands; and a new lighthouse will have to be erected on some adjacent site. It has been suggested that the Eddystone rocks might be removed, and a lighthouse dispensed with, but to obtain a safe depth of water of seven fathoms over these rocks, about 1,750,000 tons of rock would have to be removed by blasting; and also about 250,000 tons of rock from the Hard Deeps Shoal, forming a total of about 2,000,000 tons, the cost of this has been estimated at £500,000. The Elder Brethren of the Trinity House have decided to erect a new lighthouse, without giving further consideration to the question of the removal of the rocks, as they consider, that in addition to being a warning against a particular danger, the light in that position is invaluable in affording a leading light into Plymouth, and also in serving as a link in the chain of lights for directing vessels going up or down the Channel.

FATHER SECCHI.—This illustrious spectroscopist and astronomer died at Rome on February 26th, after a brief but painful illness. Angelo Secchi was born at Reggio in Italy on July 29, 1818, and received his education from the Jesuits. After a course of physics and mathematics he emigrated to America in 1848, and taught these subjects in Georgetown College, where he made the acquaintance of Professor Henry, the leading physicist of America. His friendship with Henry probably directed him to the rising science of spectroscopy, which he has since laboured at so successfully. He returned to Europe in 1850, and was made director of the Observatory of the Collegio Remand, where he was happily left free to prosecute the solar researches to which he was now devoted. The sun, its nature, origin and growth and its influence on the planetary system which depends upon it, was the sphere of his life work, and he has summed up all that we know concerning it all the researches and the theories of himself and others, throwing light upon it, in his great book, "The Sun." Secchi maintains that the solar heat is due, not to the influx of meteoric masses upon the sun's body, but to gravitation of the gaseous mass towards its centre. He shews that by the principle of the dissociation of gases the loss of temperature by the sun does not exceed 1° C. in 4000 years, and from this concludes that the time when the earth will be too cold to support life is as yet very remote. He admits that the earth's mass is being slowly increased by falling meteorites and cosmical dust, and finds in this fact the cause of the observed secular increase of the moon's velocity. Between the years 1858 and 1870, Father Secchi carried on a series of magnetic observations, at the expense of the Papal Treasury, for the purpose of elucidating the supposed connection between magnetic phenomena and solar spots. His results shewed that years rich in solar spots were also rich in magnetic storms. He also studied earth currents for several years on a line 31 miles long, and found that they always exist in greater or less degree, that they have a prevalent direction, and that they are of abnormal intensity during magnetic disturbances. From the total eclipse of 1865, Secchi obtained a classical series of photographs of the solar disc, showing the red flames in great number and variety. It was now seen that these flames were a true solar phenomena. In 1870 he observed the eclipse from Agosta, and succeeded in proving that different parts of the corona gave different spectra. Secchi was appointed by Pope Pius IX. to continue the trigonometrical survey of the Papal States; and obtained the great prize of a hundred thousand francs at the Paris Exhibition of 1867, for his "meteorograph." He was a member of many learned bodies, and founded the Italian Spectroscopic Society.

A GAS well in Kansas is said to be used for raising steam, cooking, and illuminating.

IT is stated that the Eucalyptus cannot be proof against fire as has been reported, since it is employed as fuel in Australia. There is no doubt, however, that it is superior to most woods in resisting the ravages of *termites* or white ants.

LIQUEFACTION OF AIR.—Attention has been called to the forgotten researches of Mr. Perkins "On the Compressibility of Water, Air, and other Fluids," a short account of which appeared in Thomson's *Annals of Philosophy*, N.S., Vol. VI., 1823, and a fuller account in the *Philosophical Transactions* for 1826. In both of these Mr. Perkins announced that he had liquefied atmospheric air, and other gases, by a pressure of upwards of 1000 atmospheres, thus anticipating the late famous achievements of MM. Pictet and Cailletet His apparatus was very similar to that employed by M. Cailletet, and he thus describes his results: "In the course of my experiments on the compression of atmospheric air by the same apparatus which had been used for compressing water, I observed a curious fact which induced me to extend the experiment, viz., that of the air beginning to disappear at a pressure of 500 atmospheres, evidently by partial liquefaction, which is indicated by the quicksilver not settling down to a level with its surface. At an increased pressure of 800 atmospheres, the quicksilver was suspended about $\frac{1}{8}$ of the volume up the tube or gasometer; at 800 atmospheres it remained about $\frac{1}{4}$ up the tube; at 1000 atmospheres, $\frac{3}{8}$ up the tube, and small globules of liquid began to form about the top of it; at 1,200 atmospheres the quicksilver remained $\frac{3}{4}$ up the tube, and a beautiful transparent liquid was seen on the surface of the quicksilver, in quantity about $\frac{1}{3000}$ part of the column of air. On another occasion a second tube was charged with "carburetted hydrogen" and subjected to pressure; it began to liquefy at about 40 atmospheres, and at 1,200 atmospheres the whole was liquefied. These results were obtained in January, 1822, and Mr. Perkins, from lack of chemical knowledge, could not say definitely that the liquids obtained were what they appeared to be; but left the matter for others more learned to judge. In connection with this subject Professor T. E. Thorpe, in a letter to *Nature*, points out that it is not strictly true that all gases have now been liquefied, the most recently-discovered gas—phosphorus pentafluoride—not having as yet been seen in the liquid state.

AMERICAN RAILWAY CARS.—At the meeting of the Institution of Civil Engineers, on March 12, Mr. Douglas Galton, C.B., F.R.S., read a paper on the "Railway Appliances at the Philadelphia Exhibition of 1876," from which we extract the following information concerning the American carriages:—The great distances on American lines has led to the conversion of the passenger cars into travelling hotels. The main advantage of the American form of car, which consists of a long body supported at each end on a bogie truck, is the power of movement afforded to the passengers, and of access to conveniences. The disadvantages are the mode of opening the windows, which slide up instead of being let down into the panels, and the difficulty of ventilation, but the latter has been overcome by a central raised roof with clerestory windows. A car for sixty persons has a length of body of 48 feet, a width of 9 feet 6 inches, and a height of 7 feet 10 inches at the sides and of 10 feet 3 inches in the the centre. Such a car would weigh, when empty, 650lbs., and when full 783lbs. per passenger. Sleeping cars for sixty-four persons are made with a body 61 feet long, and weighs when empty 812½lbs., and when full 945½lbs., per passenger. A class of vehicle, recently adopted, seems likely to come into greater use. This is the refrigerator car, by which the produce of California is brought to the Eastern States, and the delicate fruits of the South, and fish from the Gulf of Mexico are taken to Chicago. These cars are fitted with ice-boxes, and are of various patterns. A very efficient cooling surface is provided by two ice chambers on each side of the car, or four in all, extending from the top to the bottom, and fed through hoppers in the roof. These boxes being placed 3 inches from the sides allow a free circulation of air all round. Cars were formerly heated by open iron stoves, but these have been the cause of many frightful fires, and the Baker car-warmer is now the means in favour. By this the heat is supplied from hot-water pipes laid round the car on the floor-level, the water being heated in a coil of the pipe which passes through a circular iron stove. The fire-box of this stove is of wrought iron, and this again is contained in a second covering of iron, terminated in a chimney. There is no instance on record of fire having been caused by this appliance. For the circulation, both ends of the pipe are inserted in a close cylindrical cistern on the roof of the car. The liquid used is a saturated solution of salt and water, as this solution does not freeze at ordinary low temperatures. The safety valve has a compressible india-rubber ball, as the crystals, of salt prevent a metal seated valve from shutting tightly. The average allowance of heating surface in an ordinary car is 11 feet of 1¼ inch pipe per passenger.

NEW SOURCE OF ERROR IN COMPASSES.—A correspondent in the *American Polytechnic Review* draws attention to a hitherto unsuspected source of error in readings taken on a magnetic compass. The writer found a singular unsteadiness in the needle of his surveying compass, and ultimately traced it to the ebonite ring surrounding the lense of the magnifier which was fixed over the compass card for the purpose of reading the scale. The ring was polished, and it was found to have become highly electrified by friction in handling it. The electrification attracted the slender

needle delicately poised and insulated on its pivot-piece of agate, and caused an uncertainty in the observations. This disturbance was found to be greatest in dry cold weather, and when the ebonite case was new and clean. Examination of other magnifiers, such as those with brass, German silver, and horn frames, all of them showed signs of magnetic attraction arising from impurity.

BALATAH. — A German contemporary states that "balatah," the hardened milk of the bully-tree found on the banks of the Amazon and Orinoco Rivers in Guiana, has been lately imported as a substitute for gutta-percha which it greatly resembles. It is tasteless, smells like gutta-percha when warmed, has the same leathery toughness, but is even more elastic. It becomes plastic at 50° C., and melts at 150° C. It is partly soluble in pure alcohol and ether, wholly soluble in tepid turpentine, and in cold benzol and carbon di-sulphide. It is unaffected by caustic alkalies, and concentrated hydrochloric acid; but warm concentrated nitric and sulphuric acids have the same corrosive action upon it that they have on gutta-percha. It becomes strongly electrified when rubbed, and as it is a better non-conductor of heat than gutta-percha, it is probably a better non-conductor of electricity also. Its higher melting point is also in its favour over gutta-percha. Each tree yields from one-third to one-half a a kilogramme of "balatah" per year. This substance is evidently worthy the attention of our cable manufacturers.

MINERAL WEALTH OF TURKEY.—The Grand Vizier is doing his best to create new resources, but he is nearly at his wits end. As a last expedient he proposes to lease the working of the coal mine at Heraclea, on the Black Sea, in security for a new loan he is trying to negotiate. This mine produces a good coal, and, as it lies near the sea, there is but little difficulty in the transport of coal. The Turks have never been successful in mining operations. They have but few men of practical science, and then there is so much rascality among their officers that there is but little net revenue from such undertakings. They are too jealous of foreigners to concede their mines to them. The empire abounds in mineral wealth of all kinds, particularly Thessaly, Bosnia, and Asia Minor. On the slopes of Olympus, in the vale of Tempe, an English company has for many years been engaged in mining operations, chiefly among the silver and gold deposits embedded in the fanes of this rendezvous of the gods of Grecian fable. This is the only foreign company of any note that has been able to obtain a valuable concession in the mineral districts. Bosnia abounds in copper, lead, zinc, silver, and iron of the first quality. Should it fall into the hands of Austria, as it is likely to do in the settlement of the Eastern Question, it will prove a source of great wealth to that government. It is the opinion of a celebrated Russian scientific writer, who explored Asia Minor in detail some ten years ago, and who published the results of his survey, that the sands of the Pactolus if properly worked would afford from the accumulated deposits it has piled up on its shores a rich yield in gold, if not as great as it did to Croesus, yet in quantities that would astonish the world. At various epochs, the Pactolus has received its fame as a gold bearing stream. The grains of this precious ore formed in its bed and on its shores, are, no doubt, triturated from the quartz rocks in the mountains where lie its foundations. In the time of the Lydian Kings, the gold treasure of the Pactolus made Sardis the richest city in the eastern world. Shafts sunk in the bowels of the mountain, and crushing mills after the California pattern might render the Pactolus and its mountain region as famous as in ancient times.—*Engineering and Mining Journal* (American).

SUBMARINE LAMP. — Messrs. Barnet and Foster's submarine lamp consists essentially of a spirit lamp flame, fed by a jet of pure oxygen. The spirit lamp with its lense is very light and is easily carried in the diver's hand. The oxygen is contained in a wrought iron bottle where it is compressed to about thirty atmospheres, and communicates with the lamp by a short flexible pipe. The light is very brilliant and lasts about four hours. Provision is made for the products of combustion escaping from the lamp by suitable valves. The great advantage of this lamp is its self-dependence, since no pipes or electrical connections with the surface are required.

FORM OF METEORITES.—In the manufucture of Portland cement at Vienna, a stream of air is projected against the blocks of stone heated to a white heat, and it has been noted that the angles of the stone are frayed away to dust by the impinging air. This fact has suggested to M. Suss an explanation of the rounded form of meteorites, which traverse the air in a state of incandescence.

PREPARING SODIUM AMALGAM.—To do this without danger, Mr. H. N. Draper recommends allowing the mercury to run in a thin stream to the melted sodium, which is to be held in a bath of paraffin. The quantity of mercury added depends on whether solid or liquid amalgam be desired. Liquid amalgam can be poured off, and solid amalgam congeals sooner than the paraffin. Any paraffin adhering to the amalgam can be washed off by means of ether.

HARDENED GLASS.—Herr Lamek, a German chemist, warns his scientific brethren that vessels of hardened glass are very apt to break spontaneously, that is, without any appreciable shock being given to them. On one occasion with him, a filtering flask in quite an undisturbed position suddenly burst into a thousand pieces, several of which struck his face. This defect has, we believe, been found to be due to over-hardening, and

can be readily detected by a polarisator, which shows a prevalence of violet tints in over-hardened specimens; and by exposure to water at a certain temperature. It can therefore be guarded against in future.

COATING IRON WITH PLATINUM.—M. Dodé of Paris, the inventor of platinum mirrors, has patented a process for this purpose in England. The iron article to be coated is first brushed over with a compound, formed by mixing 22 parts of borate of lead and 4½ parts of cupric oxide, in oil of turpentine. Over this is laid the platinum compound, formed by converting 10 parts of platinum into chloride and mixing this chloride with 5 parts of ether, which is then permitted to evaporate in the air, the residuum being mixed with a viscid combination of 20 parts of borate of lead; 11 parts of red lead; and some oil of lavender; and 50 parts of amyl-alcohol is added to the whole. This compound is applied by dipping the object into it and allowing it to dry in the open air, then heating it to a moderate temperature.

THE ZODIACAL LIGHT AND AURORA.—Mr. Trouvelet of Cambridge, Mass., U.S., states that his observations of the zodiacal light and the aurora during the last seven years indicate a connection between the two phenomena, for when the zodiacal light was particularly bright it was generally followed by an auroral display.

TEMPERATURE OF THE HEAD.—Dr. Lombard has recently communicated the results of some experiments of his on this subject. From these it appears that the mental activity raises the temperature of the head. So also does rousing the attention. Different regions of the head are found to have different temperatures, at least when the brain is in a quiescent condition. The experiments are being continued.

A CURIOUS PHENOMENON. — The Westinghouse Automatic Brake Company are exhibiting at their office in St. Stephen's Palace Chambers, Westminster, a working apparatus which displays the action of the brake upon a train. The apparatus consists of the platform of a single carriage, with the brake levers fitted to the wheels; and upon the platform are the brake cylinders of the other carriages of a long train, placed side by side, but yet separated by the same lengths of tubing which would intervene between them in a train. The whole action of the brake, the means of putting it off and on, and of graduating its force, may thus be conveniently studied, and the instantaneous character of its working is beautifully shown. Appended to the brake gear is a nozzle, arranged for the exhibition of a curious phenomenon which was first observed at Philadelphia. By turning a tap, a jet of air, released from great compression, issues from the nozzle, and this jet of air will support two or three balls, as balls are often supported by a fountain. The peculiarity of the effect, however, is that the jet need not be vertical, but that it will support the balls when the course of the air is at an angle of 45 degrees with the horizon. If the force of the jet in these circumstances is diminished, the balls do not fall vertically, but backwards along the oblique line of the stream of air so as to come nearer to the nozzle. The balls may be of any material, as glass, wood, or india-rubber; but a hollow india-rubber ball, which is of equal thickness throughout, displays some curious phenomena of rotation. When placed in the jet it soon begins to spin, and as the speed of its rotation increases its shape gradually changes and it becomes first an oblate spheroid, and ultimately an almost flattened disc. As it flattens, its axis of rotation gradually turns round, and, when this axis comes to be at right angles to its original position, the speed of the rotation diminishes, and the ball ultimately comes to rest. For a moment it remains motionless, supported by the jet, and then it begins to spin round again upon an axis, and repeats the former changes of position and of speed *ad infinitum*. At the International Exhibition at Philadelphia these rotating balls attracted great attention, and some of the most eminent mathematicians in the United States were occupied in formulating the laws which governed their movements.—*The Engineering and Building Times.*

FOSSIL METEORITES. — MM. Meunier and Gaston Tissandier have found, from microscopic studies, that certain ancient rocks of the cretaceous, liassic, triassic, permian, carboniferous and Devonian series, contain small magnetic spherules absolutely similar to those which have been detected in the atmospheric or cosmical dust.

PREPARING CAOUTCHOUC ON THE AMAZON.—Narrow paths lead from the hut through the thick underbrush to the solitary trunks of the thick India-rubber trees; and as soon as the dry season allows, the woodman goes into the seringal with a hatchet, in order to cut small holes in the bark, or rather in the wood of the caoutchouc tree, from which a milky white sap begins to flow through an earthenware spout fastened to the wound. Below is a piece of bamboo which is cut into the shape of a bucket. In this way he goes from tree to tree until upon his return, in order to carry the material more conveniently, he begins to empty the bamboo buckets into a large calabash. The contents of this are poured into one of those great turtle-shells, which on the Amazon are used for every kind of purpose. He at once sets to work on the smoking process, since, if left to stand long, the gummy particles separate, and the quality of the India-rubber is hurt. This consists in subjecting the sap, when spread out thin, to the smoke from nuts of the Urucury or Uauassa palm, which, strange to say, is the only thing that will turn it solid at once. An earthenware "bowl without bottom" whose neck has been drawn together like that of a bottle, forms a kind of chimney when placed over a heap

of red-hot nuts, so that the white smoke escapes from the top in thick clouds. The workman pours a small quantity of the white, rich, milk-like liquid over a kind of light wooden shovel which he turns with quickness, in order to separate the sap as much as possible. Then he passes it quickly through the dense smoke above the little chimney, turns it about several times, and at once perceives the milk take on a grayish yellow colour and turn solid. In this way he lays on skin after skin until the India-rubber on each side is two or three centimeters thick, and he considers the *plancha* done. It is then cut upon one side, peeled off the shovel, and hung up to dry, since much water has got in between the layers, which should dry out if possible. The colour of the plancha, which is at first a bright silver gray, becomes more and more yellow, and at last turns into the brown of caoutchouc, as it is known in commerce. A good workman can finish in this way five or six pounds an hour. The thicker, the more even and freer from bubbles the whole mass is, so much the better is its quality and higher the price.—*Scribner's* (American) *Magazine.*

Olive-growing in New Zealand.—A report under Government authority has recently been published in New Zealand for the purpose of encouraging the introduction of olive cultivation into the Northern Island. It appears from this that the finest qualities of olives are produced between the 43rd and 45th parallels of latitude in the neighbourhood of the sea. It is therefore probable that it could be cultivated successfully in the southern hemisphere.

A Gigantic Earth-worm is supposed to exist in Southern Brazil. It is called the "minhocca," and is reported to have been seen several times at different places during the last five and twenty years. In short it has a reputation like the great sea serpent. It is said to be fifty feet in length and five feet thick, with a snout like a pig, and a coat of armour. It is also said to make deep channels in the soil, to uproot pine-trees, and to haunt morasses and the banks of streams.

Colour Blindness.—It is stated that five per cent of the population of Germany, England, France, and Sweden are colour-blind. Dr. Stilling of Cassell, has published a set of charts for the use of railway and shipping companies in testing the powers of their *employés* to discriminate colours. They consist in chequers of different coloured squares, and the person on trial is required to count the number of squares from one point to another. If colour-blind he will be unable to do this correctly. Complete colour blindness is very rare. It generally happens that a person is blind to a pair of complementary colours, and these are either red and green, or blue and yellow. The man who is blind to red is also blind to green; and the red of the spectrum appears dark yellow to him; green up to a certain point in the spectrum appears pale yellow, and beyond that point blue; while violet seems to be dark blue. Sometimes this insensibility to red or other rays is so great that they cannot be perceived at all, red or green light not being distinguishable from darkness.

Action of Crookes' Radiometer.—According to the most recent determination, the number of molecules contained in a cubic centimeter of air at ordinary pressure, is probably something like 1,000,000,000,000,000,000,000; and consequently in a vacuum of 0·0001 of a millimetre pressure there still remain 100,000,000,000,000 molecules. Mr. Crookes considers this number sufficient to justify the hypothesis of Mr. Stoney, which explains the action of the radiometer as due to a molecular bombardment of the vanes. When these molecules are set into vibration by a heated platinum wire, they can exercise great mechanical power.

A second edition of Thomson and Tait's Natural Philosophy is, we believe, in the press.

City Notes.

Old Broad Street, March 29, 1878.

The first ordinary general meeting of the reconstructed Direct United States Cable Company was held on the 22nd instant. During the half year from July 1 to Dec. 31, the revenue, after deducting payments to the associated companies, was £84,217. Of this amount the working expenses, cost of repair, interest on debentures of the old company, absorbed £25,046, a net profit of £59,171 remaining. Out of this, it was stated that two quarterly interim dividends of 1¼ per cent. had already been paid, being at the rate of 5 per cent per annum; £12,500 had been set aside for reserve, while £16,309 had been carried forward to the next half year. In many respects, the report is satisfactory, and we are not surprised that the meeting terminated without much discussion. The chairman, we notice, said he entertained no fear of new cables being laid "under present financial circumstances," but financial circumstances, which we admit are not just now satisfactory, may change; when they change, will Mr. Pender begin to fear? We are quite prepared to believe that one of the objects of the Direct board is to maintain friendly relations with Governments and other companies—the former especially—and, in the estimation of the directors of the Direct Company, the rates for messages are, probably, as low as they think desirable or reasonable. But, for all that, they are, as we have over and over again reiterated, too high, and the public, long suffering as it is, will eventually kick against them. The report of the directors was adopted unanimously, and in the course of the proceedings it was mentioned, with regret, that Lord Bury had retired from the Board, in consequence of his appointment to the Under Secretaryship of State for War. The shareholders of the Company have certainly lost a good man.

The report of the Indo-European Co., the general meeting of which was held on Thursday, for 1877, is an extremely interesting document. In May last the company's line of telegraph along the Black Sea Coast was destroyed, owing to the operations consequent upon the Russo-Turkish war—the report speaks of it as the

late Russo-Turkish war—and it appears that as the work depended upon the result of those operations, the period within which the construction of the wires could be effected was entirely unknown. The directors, however, having obtained permission from the Russian government to erect a wire on the government line from Kertch, by Mineralin-Wodi to Tiflis as an alternative route, entered into a contract with Messrs. Siemens to do the work, and the five hundred and twenty miles were completed, the necessary stations opened, and the company's through communication with India restored on the 22nd of August—a fact which is creditable alike to the directors and to Messrs. Siemens. In the report it is significantly pointed out, that although one wire of the interrupted line along the Black Sea Coast was temporarily repaired on the 12th of January, the company would, if the directors had not promptly entered into an arrangement with Messrs. Siemens, have been deprived of revenue for eight months instead of three—a very considerable difference. It is stated that communication by a second wire of the Black Sea Coast line was secured on the 4th of February and the repairs are being proceeded with. We learn also that the company have made a claim upon the Russian Government for expenses occasioned and loss of revenue sustained. We hope that a substantial sum will be exacted. Of course, the revenue for the year was less than that of 1876, but the expenses show a reduction of £1,660, in spite of the maintenance charges having been heavier. The balance available for dividend is £15,580, and of this sum £2,830 will be carried forward, the dividend being fixed, as briefly mentioned in our last, at 3 per cent., free of income-tax. There is nothing in the statement of accounts to call for special remark. We notice under the heading of suspense an item of £5,194, which is due to Messrs. Siemens and Co. "when recovered." This may seem rather a singular way of discharging a liability, but Messrs. Siemens were consenting parties to this arrangement several years ago.

We suppose that Mr. Silver, who presided at the meeting of the India-rubber, Gutta-percha, and Telegraph Works Company the other day, recommended the best course that was possible to the shareholders, considering the circumstances. It is not pleasant to have to advocate the reduction of capital, but, at any rate, Mr. Silver made no attempt to represent things as they are *not* to the shareholders of the company. We cannot—Mr. Silver did not either—pretend to think that it would be a desirable practice for a public company to ask its shareholders to accept shares of another enterprise in lieu of shares in their own. Yet, as Mr. Batewell justly urged, the share which the shareholders of the India-rubber Company have agreed to receive is equal in value to what they had given. Their interest in the India-rubber Company has been lessened, and they have now an interest in the West Coast of America Telegraph Company. It is significant that no amendment to the Chairman's proposals was suggested.

We should not care to be holders of preference shares in the Direct Spanish Telegraph Company; we will say nothing about ordinary shareholders. But it does not look healthy when a company is obliged to carry forward to another half-year an arrear of 1s. 9d. on the preference shares. A little more business, or a little more economy, might have rendered this confession of weakness unnecessary. Undoubtedly the directors are unable to help the fact that the traffic of their cables was not greater—and it is something to be in a position to assert that the cables themselves have worked perfectly for six months—but we are disposed to think that the figures on the debit side of the profit and loss statement might here and there have been a trifle lighter. The actual items are, certainly, all small; but then the company is a small one. Considering that in six months it earned only £5,046, two hundred pounds for directors' remuneration is, some would urge, more than ample. Stationery too is put down at £94, or indeed with £50 from "stationery stock" it amounts to £144, a formidable sum in such a statement. On first looking at the balance-sheet our attention was arrested by an item, "Amounts due outstanding (telegrams)" £5,730 17s. 0d., but it is explained that £3,017 9s. 6d. has been paid since the 1st of January. Still, the sum due for outstanding telegrams exceeded the entire sum received for them during the half-year. The meeting of the company is being held as we go to press.

The directors of the Brazilian Submarine Telegraph Company have declared an interim dividend of two shillings and sixpence per share at 5 per cent. per annum, free of income tax, for the quarter ending December 31st.

At their meeting the Directors of the Anglo-American Telegraph Company resolved, after placing £37,500 to the renewal fund, to declare an interim dividend for the quarter ending the 31st inst. of 1 per cent. on the ordinary stock and of 2 per cent. on the preferred, both free of income tax, leaving a balance of about £7,500 to be carried forward to the next account.

The Eastern Telegraph Company announces the payment of an interim dividend of 2s. 6d. per share on the Ordinary Shares of the Company, free of income tax, on the 15th April next, in respect of the profits for the puarter ending 31st December, 1877. A dividend of 3s. per share on the Six per Cent. Preference Shares, less income tax, for the quarter ended 31st March, 1878, will be paid on the same date. The register of transfers will be closed from the 8th to the 15th April, both days inclusive. The half-yearly interest on the Six per Cent. (1883) Debentures will be paid on the 15th April, at the banking-house of Messrs. Glyn, Mills, Currie, & Co., 67, Lombard-street.

The directors of the Eastern Extension Australasia and China Telegraph Company (Limited) announce a dividend for the quarter ended 31st December, 1877, of 2s. 6d. per share, free of income tax, making with previous payments a total of 5 per cent. for the year 1877, carrying £30,905 to reserve.

The directors of the Great Northern Telegraph Company announce their intention of paying a final dividend of 2s. 9d. per £10 share—in addition to the 5 per cent. already paid—to carry forward £19,277 and to add £30,539 to the reserve, which fund will then stand at £85,542.

The directors of the Western Union Telegraph Company notify that a dividend of 1½ per cent. will be declared, and a balance of 136,743 dols. carried forward. The returns for the quarter appear to be fairly satisfactory.

We notice an advertisement in a contemporary, signed S. F. Van Choate. We may probably direct attention to this in our next issue.

It is announced that Mr. John Hollocombe, a member of the Platino-Brazilian Telegraph Company's Shareholders' Committee, has sailed for Rio de Janeiro, in order to carry the necessary resolutions for the transfer of the Company to London. Telegraphic advices have been received from the board in Rio that the transfer of the Company will be passed at the meeting of shareholders, to attend which Mr. Hollocombe has gone to Brazil. As Mr. Pender is the chairman of the committee in question, it may be assumed that the transfer means something. Are the fortunes of the shareholders of the Western and Brazilian Company about to be realised?